

SCIENTIFIC AMERICAN MIND

ANTAGONISTS AND THE PEOPLE WHO LOVE THEM

They're aggressive.
They retaliate.
And yet they get
elected as leaders
and excel in society.
Why?

INCLUDING

AN APP THAT
PREDICTS HOW
YOU'LL FEEL

THE JOYFUL
SOUNDS OF
DEATH METAL

NEED
PURPOSE?
IGNORE YOUR
PASSIONS

WITH COVERAGE FROM

nature

FROM
THE
EDITOR

LIZ TORMES



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Mean Guys Finish First

Many of us could easily name someone in the public eye (or even our private circle) whose aggressive personality only seems to get them more ahead in life. Do nice guys (and gals) truly finish last? *Scientific American* columnist Scott Barry Kaufman digs into this question in “[The Personality Trait That Is Ripping America \(and the World\) Apart](#),” especially as it pertains to political beliefs. It turns out that highly antagonistic leaders have a special ability to fire up certain groups of people who share some of those antagonistic personality tendencies. Talk about screaming into the echo chamber.

Elsewhere in this issue, psychologists are developing apps that, they claim, can predict severe mood crashes—especially important for patients suffering from depression, as Matt Kaplan reports in “[Happy, with a 20 Percent Chance of Sadness](#).” And Cindi May, professor of psychology at the College of Charleston, makes the case that rather than follow our passions down one career path, we should invest in different interests and multiple fields (see “[Life Advice: Don’t Follow Your Passion](#)”). As always, we welcome your feedback. Enjoy!

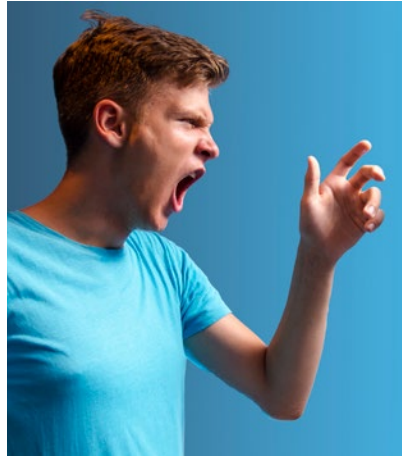
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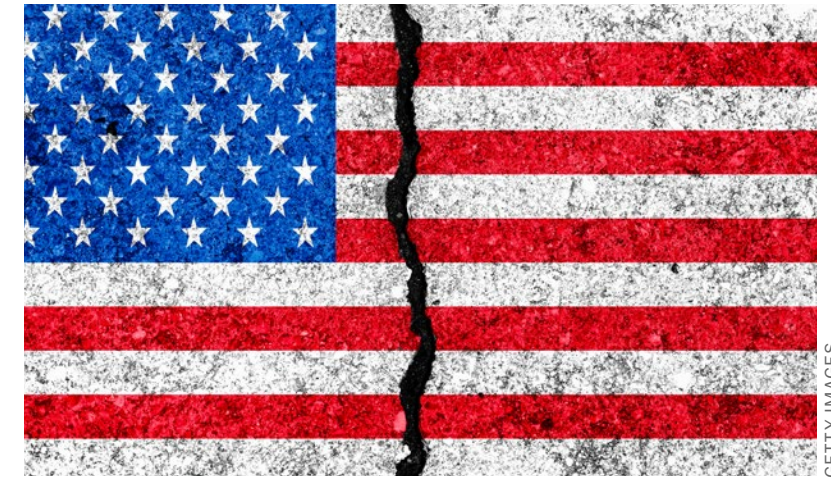
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“Stress Hormone” Cortisol Linked to Early Toll on Thinking Ability

Brain changes, visible on scans, are also associated with Alzheimer’s precursors

THE STRESSES OF everyday life may start taking a toll on the brain in relatively early middle age, new research shows. The study of more than 2,000 people, most of them in their 40s, found those with the highest levels of the stress-related hormone cortisol performed worse on tests of memory, organization, visual perception and attention.

Higher cortisol levels, measured in subjects’ blood, were also found to be associated with physical changes

in the brain that are often seen as precursors to Alzheimer’s disease and other forms of dementia, according to the study published in October in *Neurology*.

The link between high cortisol levels and low performance was particularly strong for women, the study found. But it remains unclear whether women in midlife are under

more stress than men or simply more likely to have their stress manifested in higher cortisol levels, says lead researcher Sudha Ses-hadri. A professor of neurology, she

splits her time between Boston University and the University of Texas Health Science Center at San Antonio, where she is the founding director of the Glenn Biggs Institute for Alzheimer's & Neurodegenerative Diseases.

Working on the study “made me more stressed about not being less stressed,” Seshadri says, laughing. But, she adds, the bottomline is serious: “An important message to myself and others is that when challenges come our way, getting frustrated is very counterproductive—not just to achieving our aims but perhaps to our capacity to be productive.”

The study is the largest of its kind to look at these factors and tightens the link between cortisol, midlife stress and brain changes, says Pierre Fayad, medical director of the Nebraska Stroke Center at the University of Nebraska Medical Center, who was not involved in the new research. “It confirms some of the previous suspicions,” he says. “Because of its quality, it gives a lot more credibility.”

Bruce McEwen, a neuroscientist and cortisol expert at the Rockefeller University, who also was not part

Working on the study “made me more stressed about not being less stressed.”—Sudha Seshadri

of the study, says he found it “frankly remarkable.” Cortisol, he notes, is necessary for life—so it is obviously not all bad. But stress can lead people to potentially problematic behaviors such as smoking, drinking and eating unhealthy food. “Cortisol is itself the tip of the iceberg of things that are going on in a person’s life and a person’s body,” he says.

The new research included volunteers from the Framingham Heart Study, a 70-year-old study of residents from a Boston suburb. Researchers are now studying the grandchildren of the original participants, most of whom were white, middle class and suburban, Seshadri says. Although the scientists did not ask participants what kinds of specific stresses they were under on the day their blood was drawn, she says the volunteers were able to come in for a three-to four-hour examination—so “you

would say they were at a reasonably stable point in their life.”

Yet even these relatively young and apparently well-off people showed signs of brain changes, both in brain scans and in their performance. “This is the range of stress that a group of average Americans would experience,” Seshadri says. The highest cortisol levels were associated with changes that could be seen on an MRI scan of the brain, the study found.

Cortisol does not distinguish between physical and mental stress, so some of the people with high levels might have had physical illnesses such as diabetes that drove up their cortisol levels, Seshadri says. It is also possible levels of the hormone might spike in people’s blood if they are already undergoing brain changes—that is, the elevated cortisol could be the result of the changes rather than

their cause—she says. But she thinks this is unlikely because the trial participants were so young. Each subject’s cortisol level was measured only once (in the morning), so the measurements do not reflect changes over time or variations throughout the day, she notes.

The volunteers were given tasks such as copying a shape they were shown or being asked to repeat a story they had been told 20 minutes earlier. The differences in performance were subtle, Seshadri says. She could not immediately tell whether subjects had higher or lower cortisol levels based on how well they carried out the tasks. “It was more that in terms of group averages there was a real difference,” she explains.

Earlier research has shown weaker-than-average performances on tests like these are associated with a higher risk of dementia

decades later, and Seshadri says high stress levels in midlife might be one of many factors that contribute to dementia. Understanding that link might offer a potential opportunity to reduce risk—but she cautions research has not yet shown conclusively that lowering cortisol levels will reduce the risk of Alzheimer’s.

Other research has shown cortisol levels can be reduced with adequate sleep, exercise, socializing and relaxing mental activities such as meditation. “There are a number of intriguing, fairly simple things that have been shown to change these levels,” Seshadri says. “But whether they will in turn translate into better preservation of the brain is something that can only be determined in a clinical trial.”

Rockefeller University’s McEwen says other research suggests it is never too late to adopt a healthier lifestyle by taking steps like reducing stress, exercising regularly, eating a healthy diet, getting enough good-quality sleep and finding meaning in one’s life. “The life course is a one-way street,” he says. But “the brain does have the capacity for repairing.”

—Karen Weintraub

Yes, Violent Video Games Trigger Aggression, but Debate Lingers

A study tries to find whether slaughtering zombies with a virtual assault weapon translates into misbehavior when a teenager returns to reality

INTUITIVELY, IT MAKES SENSE. Splatterhouse and Postal 2 would serve as virtual training sessions for teens, encouraging them to act out in ways that mimic game-related violence. But many studies have failed to find a clear connection between violent game play and belligerent behavior, and the controversy over whether the shoot-‘em-up world transfers to real life has persisted for years. A new study published on October 1 in the *Proceedings of the National Academy of Sciences USA* tries to resolve the controversy by weighing the findings of two dozen studies on the topic.

The meta-analysis does tie violent video games to a small increase in physical aggression among adoles-



cents and preteens. Yet debate is by no means over. Whereas the analysis was undertaken to help settle the science on the issue, researchers still disagree on the real-world significance of the findings.

This new analysis attempted to navigate through the minefield of conflicting research. Many studies find gaming associated with increases in aggression, but others identify no such link. A small but vocal cadre of researchers have argued much of the work implicating video games

has serious flaws in that, among other things, it measures the frequency of aggressive thoughts or language rather than physically aggressive behaviors like hitting or pushing, which have more real-world relevance.

Jay Hull, a social psychologist at Dartmouth College and a co-author on the new paper, has never been convinced by the critiques that have disparaged purported ties between gaming and aggression. “I just kept reading, over and over again, [these]

criticisms of the literature and going, ‘That’s just not true,’” he says. So he and his colleagues designed the new meta-analysis to address these criticisms head-on and determine if they had merit.

Hull and his colleagues pooled data from 24 studies that had been selected to avoid some of the criticisms leveled at earlier work. They only included research that measured the relationship between violent video game use and overt physical aggression. They also limited their analysis to studies that statistically controlled for several factors that could influence the relationship between gaming and subsequent behavior, such as age and baseline aggressive behavior.

Even with these constraints, their analysis found kids who played violent video games did become more aggressive over time. But the changes in behavior were not big. “According to traditional ways of looking at these numbers, it’s not a large effect—I would say it’s relatively small,” he says. But it’s “statistically reliable—it’s not by chance and not inconsequential.”

Their findings mesh with a 2015 literature review conducted by the

It may instead be that the relationship between gaming and aggression is a statistical artifact caused by lingering flaws in study design.

American Psychological Association, which concluded violent video games worsen aggressive behavior in older children, adolescents and young adults. Together, Hull’s meta-analysis and the APA report help give clarity to the existing body of research, says Douglas Gentile, a developmental psychologist at Iowa State University, who was not involved in conducting the meta-analysis. “Media violence is one risk factor for aggression,” he says. “It’s not the biggest, it’s also not the smallest, but it’s worth paying attention to.”

Yet researchers who have been critical of links between games and violence contend Hull’s meta-analysis does not settle the issue. “They don’t find much. They just try to make it sound like they do,” says

Christopher Ferguson, a psychologist at Stetson University in Florida, who has published papers questioning the link between violent video games and aggression.

Ferguson argues the degree to which video game use increases aggression in Hull’s analysis—what is known in psychology as the estimated “effect size”—is so small as to be essentially meaningless. After statistically controlling for several other factors, the meta-analysis reported an effect size of 0.08, which suggests that violent video games account for less than one percent of the variation in aggressive behavior among U.S. teens and pre-teens—if, in fact, there is a cause-and-effect relationship between game play and hostile actions. It may instead be that

the relationship between gaming and aggression is a statistical artifact caused by lingering flaws in study design, Ferguson says.

Johannes Breuer, a psychologist at GESIS–Leibniz Institute for the Social Sciences in Germany, agrees, noting that according to “a common rule of thumb in psychological research,” effect sizes below 0.1 are “considered trivial.” He adds meta-analyses are only as valid as the studies included in them, and that work on the issue has been plagued by methodological problems. For one thing, studies vary in terms of the criteria they use to determine if a video game is violent or not. By some measures, the Super Mario Bros. games would be considered violent, but by others not. Studies, too, often

rely on subjects self-reporting their own aggressive acts, and they may not do so accurately. “All of this is not to say that the results of this meta-analysis are not valid,” he says. “But things like this need to be kept in mind when interpreting the findings and discussing their meaning.”

Hull says, however, that the effect size his team found still has real-world significance. An analysis of one of his earlier studies, which reported a similar estimated effect size of 0.083, found playing violent video games was linked with almost double the risk that kids would be sent to the school principal’s office for fighting. The study began by taking a group of children who hadn’t been dispatched to the principal in the previous month and then tracked them for a subsequent eight months. It found 4.8 percent of kids who reported only rarely playing violent video games were sent to the principal’s office at least once during that period compared with 9 percent who reported playing violent video games frequently. Hull theorizes violent games help kids become more comfortable with taking risks and engaging in abnormal behavior. “Their sense of right and wrong is being

warped,” he notes.

Hull and his colleagues also found evidence ethnicity shapes the relationship between violent video games and aggression. White players seem more susceptible to the games’ putative effects on behavior than do Hispanic and Asian players. Hull isn’t sure why, but he suspects the games’ varying impact relates to how much kids are influenced by the norms of American culture, which, he says, are rooted in rugged individualism and a warriorlike mentality that may incite video game players to identify with aggressors rather than victims. It might “dampen sympathy toward their virtual victims,” he and his co-authors wrote, “with consequences for their values and behavior outside the game.”

Social scientists will, no doubt, continue to debate the psychological impacts of killing within the confines of interactive games. In a follow-up paper Hull says he plans to tackle the issue of the real-world significance of violent game play and hopes it adds additional clarity. “It’s a knotty issue,” he notes—and it’s an open question whether research will ever quell the controversy.

—Melinda Wenner Moyer



How Accurate Are Personality Tests?

Precious few personality assessments are known to be reliable, and researchers say their use outside academia is debatable

IF YOU’RE LOOKING FOR insight into the true you, there’s a buffet of personality questionnaires available. Some are silly—like the Internet quiz that tells everyone who takes it that

they are procrastinators at the core. Other questionnaires, developed and sold as tools to help people hire the right candidate or find love, take themselves more seriously.

The trouble is, if you ask the experts, most of these might not be worth the money. “You should be skeptical,” says Simine Vazire, a personality researcher at the University of California, Davis. “Until we test them scientifically we can’t tell the difference between that and pseudoscience like astrology.”

One famous example of a popular but dubious commercial personality test is the Myers–Briggs Type Indicator. This questionnaire divides people into 16 different “types,” and often the assessment will suggest certain career or romantic pairings. It costs \$15 to \$40 for an individual, but psychologists say the questionnaire is one of the worst personality tests in existence for a wide range of reasons. It is unreliable because a person’s type may change from day to day. It gives false information (“bogus stuff,” one researcher puts it). The questions are confusing and poorly worded. Vazire sums it up as “shockingly bad.”

Personality questionnaires began evolving about a century ago, says Jim Butcher, an emeritus psychologist at the University of Minnesota. “They started asking questions about an individual’s thinking and behavior during World War I,” he says. “These were to study personality problems and mental health problems.” And importantly, he adds, the U.S. military wanted the questionnaires to help weed out soldiers who weren’t fit to fly military aircraft.

According to Butcher, during the first half of the 20th century many

academics started creating different personality scales. “Not just on mental health diagnoses, but what personality is like,” he says. The problem with practically all of the assessments at the time was they were built on the creators’ subjective feelings about personality, he notes. “Then people started to raise questions about do they really measure what they think they’re measuring? How reliable are those conclusions, and are they valid?”

Butcher describes what followed as a mass culling of personality systems and questionnaires by the scientific method. There is one personality model that did survive the 20th century, though. It is popular among academics today and is what Vazire uses in her research. It’s called the Big 5 Personality Traits (aka 5-Factor Model), and it was developed over three decades beginning in 1961 at Brooks Air Force Base. From then to the 1990s, several psychologists, including Lewis Goldberg, Warren Norman, Paul Costa and Robert McCrae, helped develop the model into its modern form.

Vazire says in developing the Big 5 Personality model, psychologists

tried to avoid pitfalls that plagued early personality researchers—like selecting criteria based primarily on intuition. Instead, the Big 5 model took a holistic tack by compiling every word that could be considered a personality trait and creating simple, straightforward questions about them. For example, on a scale of 1 to 5, are you outgoing, sociable? Have a forgiving nature? Based on how people answered initial surveys, researchers used statistical methods to group traits that seemed to cluster together (like “talkative” and “sociable”) into five basic categories: extraversion, conscientiousness, agreeableness, neuroticism and openness to experience. The other model, the HEXACO model of personality structure created in 2000 by psychologists Kibeom Lee at the University of Calgary and Michael Ashton at Brock University in Ontario, is similar but adds an extra category: honesty-humility.

The key to the Big 5 model is its simplicity. It doesn’t sort anybody into a “type”; it just informs them where they fall on a continuum of personality traits. There are no tricks and no surprises to be revealed,

Vazire says. “In a way, it’s disappointing. It just means that personality tests can only tell you what you tell it.” You won’t learn anything that you didn’t already know about yourself, she adds, and its accuracy comes entirely from how honest and self-reflective you were with your answers.

At best, Vazire says you could use it as a comparative tool that can tell you how you rank on extraversion compared with others who have taken the same test. There have been studies that show certain Big 5 factor scores correlate with certain outcomes—conscientiousness correlates with longer life, for instance, and extraversion correlates with higher sales for sales reps. “But that doesn’t mean someone with high extraversion will be a better salesperson,” Vazire says. Correlations are just that; they could be incidental. But commercial personality assessments seem to depend heavily on such correlations. For example, one assessment from The Predictive Index, a company that measures behavioral characteristics and matches personality profiles to jobs, views such correlations in their own studies as a measure of

success. “[We showed] in one client, a retail jeweler, that increases in dominance or aggression was responsible for \$125,000 in revenue,” says Thad Peterson, one of the company’s executives. The idea behind The Index, Peterson says, is to use those measures to help “marry people to [job] positions.”

Such personality assessments—particularly those targeted toward hiring recruiters and managers—aim to uncover a kind of “hidden truth about the person,” says Randy Stein, a psychologist at California Polytechnic State University, Pomona. “They assume that there is an essence of you and an essence of the job, and you should be matching up those two things in hiring,” he says. “But I don’t think there is a hidden truth—and even if there is, a personality test doesn’t do it.”

Like the Big 5 model, any personality or behavior assessment can’t know things you haven’t explicitly answered in the questionnaire, Stein says. Sometimes commercial

personality tests ask odd questions—like Do you identify with snakes? or How do you react to a certain color?—and try to draw inferences from your answers. Those kinds of conclusions venture into the pseudoscientific, Stein says.

There are other reasons why Stein thinks some personality assessments may be pseudoscientific. “What those tests will tell people is true or false is determined by what people are willing to pay for,” he says. “Their process as a company is to tell people whatever will sell the product.” By contrast, the Big 5 and HEXACO models were shaped by an empirical process and independent peer review that showed people’s scores tended to be consistent, and predictions made using the models are reproducible. Without that, Stein says personality tests should be treated with extreme suspicion.

Some companies like The Predictive Index say their product meets such standards. The company invested in an audit, paying over \$20,000 to

Norwegian classification firm DNV GL to review their product and certify that it complies with a standard set by the European Federation of Psychologists’ Associations. Two Index representatives, Greg Barnett and Austin Fossey, also say predictions based on their methods are accurate.

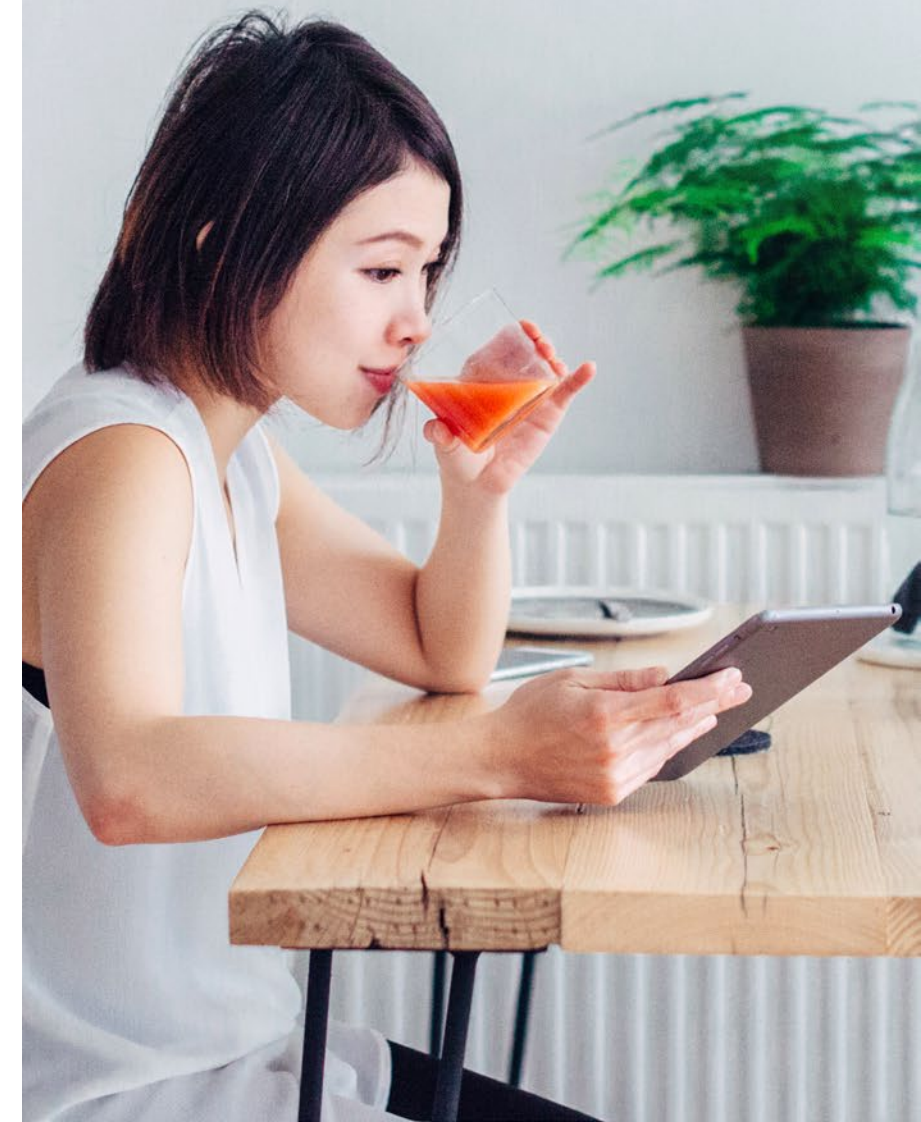
Perhaps. U.C. Davis’s Vazire says it is fairly easy to reach some level of validity. “If I just asked you to make a questionnaire on extroversion, you would probably do a pretty good job,” she says. It is because we are all judges of character, and we often do well at intuiting whom to date or hire and who we are, Vazire says. If the process seems confusing or if questions veer off into the abstract, that’s a red flag. Personality, she says, is just not that mysterious.

—Angus Chen

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Neuroscience Discovers Power of “Lesion Network Mapping”

A new technique is reviving the century-old study of brain lesions and revealing surprising things about neurological disorders like Parkinson’s disease

ONE OF NEUROSCIENCE’S foundational experiments wasn’t performed in a Nobel laureate’s lab but occurred in a railyard in 1848 when an accidental explosion sent a tamping iron through 25-year-old Phineas Gage’s forehead. Gage survived, but those studying his history detailed distinct personality changes resulting from the accident. He went from even-tempered to impulsive and profane. The case is likely the earliest—and most famous—of using a “lesion” to link a damaged brain region to its function. In the ensuing decades, to study the brain was to study lesions. Lesion cases fed most of the era’s knowledge of the brain.

One might think that modern neuroscience, with its immense



toolkit of experimental techniques, no longer needs lesions like Gage’s to parse the brain’s inner workings. Lesion studies, though, seem to be having a revival. A new method called lesion network mapping is clearing the cobwebs off the lesion study and uniting it with modern brain connectivity data. The results are revealing surprising associations between brain regions and disorders.

Thankfully, most lesions aren’t a tamping iron through the forehead.

Strokes, hemorrhages, or tumors make up most lesion cases. Nineteenth-century neurologists like Paul Broca made foundational discoveries by studying patients with peculiar symptoms resulting from these common neurological insults. Broca and his contemporaries synthesized a theory of the brain from lesions: that the brain is segmented. Different regions control different functions. Lesion studies lend a lawyerly logic to the brain: if region X is destroyed and function Y no longer

occurs, then region X must control function Y.

This logic, though, is a bit misleading. No single brain region can really control any function. The modern view of the brain is that individual functions rely on a network of interconnected brain regions working in concert. Thus, modern neuroscience views individual lesion cases as imperfect, uncontrolled experiments of nature that don’t necessarily speak to how a network controls a brain function. This point becomes obvious when researchers pool, or meta-analyze, lesion data. When looking at all of the published lesion cases for a given condition—say parkinsonism—researchers see that the lesions that cause this condition don’t occur in just one region. Lesions seemingly all over the brain cause parkinsonism and other conditions. This fact, along with the emergence of elegant experimental tools have pushed lesion studies to the sidelines of neuroscience. Some researchers, though, are attempting to revive the relevance of lesion studies—both for neurology and psychiatry. The authors of a new study published in *Brain* use the disparate locations of

lesions to their advantage—in this case to better understand the neuroanatomy of parkinsonism.

Parkinsonism is a grouping of symptoms affecting movement. It consists of slowed movement, rigid musculature, and tremor. The most common cause of these symptoms is Parkinson's disease, where dopamine-producing cells in the substantia nigra are progressively lost. Nigral cell loss in Parkinson's disease occurs through a slow degenerative process that is still poorly understood. But parkinsonism is possible without nigral degeneration, and notably can occur following a sudden lesion like a stroke or hemorrhage. Patients with lesion-induced parkinsonism aren't diagnosed with Parkinson's disease, exactly, but their slowed movement, rigid musculature and tremor are nearly identical to those with "classical" Parkinson's disease. The study compiled 29 published cases of lesion-induced parkinsonism. The lesions did not all occur in the same region, and surprisingly most were not in the substantia nigra.

The authors hypothesized that the parkinsonism-causing lesions,

despite occurring in disparate brain structures, disrupt common connectivity networks in the brain. To test this, the authors overlaid these lesion locations on a map of the brain known as the connectome—a structural map of region to region connectivity derived from functional MRI data. With the lesions applied to the connectome, the authors were able to identify networks—or tracks of connectivity—that the lesions disrupted.

Each of the 29 lesions sat within several different networks, which is to be expected as the brain is a rich tangle of connectivity. But the authors saw that 28 out of 29 cases affected networks that connected through a small, sheet-like structure called the claustrum. The claustrum is rarely discussed in the field of movement control or Parkinson's disease and is generally understudied.

An important aspect of the study is that none of the 29 lesions were to the claustrum, itself. It took the combination of the lesions and the connectome to identify the claustrum as a structure of importance for parkinsonism.

The claustrum coincidentally

appears as a rest stop, so to speak, on the network maps of almost all the lesion cases. But is this just a coincidence or is it important? To address the claustrum's importance to parkinsonism, the authors turned to patients with the more common, degenerative form of Parkinson's disease who had deep brain stimulators implanted in their brain. Deep brain stimulation is a treatment of last resort for Parkinson's disease and doesn't yield universal improvement. In most cases, stimulating electrodes are implanted into a region called the subthalamic nucleus. The precise location within the subthalamic nucleus varies from patient to patient. The authors examined the precise location of deep brain stimulators within Parkinson's disease brains and overlaid those locations onto the connectome. They saw that when electrode locations were within networks that flowed through the claustrum—presumably altering claustrum activity—patients saw better results from deep brain stimulation. This result argues that claustrum activity plays a critical role in generating parkinsonian move-

ment. Also, altering that activity provides relief from parkinsonism.

Nineteenth-century lesion studies were framed by the question: Which region controls which function? Decades of neuroscience have reframed a more nuanced question: Which regions are important to which functions? Lesion network mapping empowers lesion studies to rigorously answer this newer question. To patient communities, however, the question has always been: Can this finding help us? In the case of the claustrum and Parkinson's disease, only time will tell. Targeting treatments—like deep brain stimulation—to the claustrum, though, may be a helpful advance for those with Parkinson's disease.

—Sam Rose



THE PERSONALITY TRAIT THAT IS RIPPING AMERICA (and the World) APART

**People who are antagonistic resonate
more with populist messages**

By Scott Barry Kaufman

“First there was the “Me Generation” then “Generation Me.” Now we have empirical evidence that we live in what will become known as the “Asshole Age” otherwise known as the Twitter Era...”

— *Personality Psychologist Brent Roberts on Twitter*

“Our movement is about replacing a failed and corrupt political establishment with a new government controlled by you, the American people. ... The political establishment, that is trying to stop us, is the same group responsible for our disastrous trade deals, massive illegal immigration, and economic and foreign policies that have bled our country dry... The only thing that can stop this corrupt machine is you.”

— *Donald Trump’s Argument For America*

THERE ARE MANY DIVIDES IN THE WORLD RIGHT now. But there’s one divide, deeply embedded into the core of human nature, that helps explain many other divides. What I’m referring to is a source of human personality variation that is built right into our DNA: antagonism. By really zooming in on this trait, and understanding how antagonism interacts with environmental conditioning and messaging, we can gain a greater understanding of one of the most prominent divides in the world today: populism.

First, let’s dive in to the latest science of antagonism.

THE SCIENCE OF ANTAGONISM

The antagonism-agreeableness dimension of personality is one of the five main dimensions of personality. Like the other major dimensions of personality, this trait is normally distributed in the population. The more two people differ on this fundamental dimension, the more incom-

prehensible the other person’s behavior may seem, especially when it comes to adhering to social norms and altruistic behavior.

Agreeableness (the opposite pole of antagonism) consists of two main aspects: politeness and compassion. Politeness reflects the tendency to conform to social norms and refrain from belligerence and the exploitation of others, whereas compassion reflects the tendency to care about others emotionally. People who score high in politeness are preoccupied with fairness, whereas those who score high in compassion are more preoccupied with helping others, especially those in need.

On the other end of the pole, people with *low* levels of politeness (antagonistic people) tend to score high on measures of aggression, whereas those with low levels of compassion tend to score poorly on measures of empathy. While politeness and compassion can come apart—e.g., a person can score high in compassion but low in polite-

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ness—politeness and compassion are strongly correlated in the general population, and both aspects together comprise the overall personality domain of agreeableness.

Like all other personality variation, differences on the agreeableness-antagonism dimension are reflected in the brain. Neurologically, those who score high on agreeableness tend to show greater activation of the default mode brain network, which is associated with the ability to simulate the mental states of others and the higher-level integration of different types of information necessary for both understanding and sharing the emotional experiences of others. Agreeableness is also associated with the capacity for emotion regulation, particularly the suppression of aggressive impulses and other socially disruptive emotions. From a neurochemistry perspective, agreeableness involves the neurotransmitters testosterone (related to the inclination away from politeness and toward antagonism) and oxytocin (related to the tendency for compassion and in-group social bonding).

The antagonism-agreeableness dimension has a lot of predictive value in the real world (not just in the scientific laboratory). Antagonistic people are more likely to respond aggressively and retaliate when treated unfairly by others (although they tend to care much less about whether others are treated unfairly). At work, antagonistic people perform better than highly agreeable people after receiving an angry speech from their manager (it fires them up), whereas highly agreeable people tend to

improve their performance after their managers express happiness for their performance.

There are also deep implications of this personality dimension for politics. Politicians who are more antagonistic get more media attention and are more often elected than more agreeable politicians. In the general population, antagonistic people are more likely to distrust politics in general, to believe in conspiracy theories, and to support secessionist movements.

Antagonism isn't absolutely good or bad. Daniel Nettle speculated that all personality traits evolved to have trade-offs, and that's why variation exists in personality. From an evolutionary perspective, agreeableness has both benefits (attention to mental states of others; harmonious interpersonal relationships, valued coalitional partnerships) as well as costs (subject to social cheating and exploitation; failure to maximize selfish advantage). Nevertheless, because of the existence of such wide variation in this trait, highly antagonistic leaders can arouse and influence wide swaths of people who score high in this trait through their rhetoric and messaging.

ANTAGONISM AND RESONANCE WITH POPULISM

There has been an increasing recognition in psychology that personality traits interact with messaging from leaders. "A crucial skill for politicians is... to speak the 'language of personality'... by identifying and conveying those individual characteristics that are most appealing at a certain time to a particular constituency," note Gian Caprara and Philip Zimbardo. They found that voters select politicians whose traits match their own personality.

Along similar lines, Patti Valkenburg and Jochen Peter introduced their Differential Susceptibility to Media Effects Model (DSMM), which argues that the rhetoric and framing of a message has more cognitive and emotional impact on people who share particular dispositions

than with other people. For example, the message of hope might be more attractive to those who are more prone to experience positive affect and enthusiasm, while the message of change might be more attractive among those willing to take risks.

Perhaps *the most important* interaction in the world today, however, is that between antagonism and populism. The core feature of populism is an anti-establishment message and a focus on the central importance of the people. The anti-establishment message portrays the political elite as corrupt and evil, and disinterested in the interests of "the pure people." According to John Judis and Ruy Teixeira, the essential divide among populists is "the people versus the powerful."

In a recent series of studies, political communication professor Bert Bakker and his colleagues conducted the largest and most systematic investigation into the question: *What happens when antagonistic citizens receive an anti-establishment message?* They found strong support for the notion that the anti-establishment message of populists resonates the most with highly antagonistic people. This finding was confirmed in seven countries across three different continents. Antagonism predicted support for populists for both *right-wing* (Trump, UKIP, Danish People's Party, Party for Freedom, SVP) and *left-wing* (Podemos, Chavez) populists.

Using physiological measures, they were also able to establish the deeper emotional processes that underlie this link. Employing a measure of skin conductance (which captures activity of the sympathetic nervous system), the researchers found an increase in arousal in response to political messages that were congruent with a person's personality. In particular, antagonistic people found an anti-establishment message arousing, whereas highly agreeable people found a *pro*-establishment message arousing.

This is important because emotions play an important

role in determining how political communication affects us. Those who are more aroused by a particular message will be more likely to remember it, and to seek the message again in the long term. These findings suggest that politicians can exert substantial influence over voters by providing a message that resonates emotionally with the personality of the voter.

They also looked at authoritarianism. Authoritarianism encapsulates a preference for social order, structure and obedience. Prior research has shown that high authoritarians express less tolerance towards out-group members and support populist parties with a right-wing host ideology. Consistent with this, Bakker and colleagues found that while authoritarianism did not predict an anti-establishment message, it did predict support for Trump and UKIP, as well as any candidate with a strong anti-immigration stance. These findings suggest a second route to populism, through the particular ideology associated with right-wing populism.

IMPLICATIONS OF THE ANTAGONISM-AGREEABLENESS DIVIDE

There seems to be *something* different in the air these days. Depending on your perspective (and personality), things are either more "sinister" or they are more "revolutionary." But I think we can all agree that the political landscape and discourse has changed dramatically in only the past few years. There were always party divides, but there seems to be prominence of a different kind of divide, that between the people and politicians. As Dutch political scientist Cas Mudde notes, "today populist discourse has become mainstream in the politics of Western democracies."

It's important to emphasize that populism is an ideology that transcends liberalism and conservatism. Research shows that both liberals and conservatives are agreeable, but they are agreeable in different ways: the politeness

aspect of agreeableness is associated with a conservative outlook and more traditional moral values, whereas the compassion aspect of agreeableness is associated with liberalism and egalitarianism. Conservatism and liberalism can complement each other; society needs those in power who care deeply about the fairness of everyone and the stability of society as well as those who are more exclusively concerned with the suffering of those in need.

It's also important to recognize that populism alone isn't necessarily dangerous. A healthy democracy will include those who challenge the government and are critical of those in power. What is particularly problematic is when a highly antagonistic leader uses rhetoric that arouses the emotions of other antagonistic people and rallies them to support a particular host ideology that is pernicious. This can lead to a situation in which a high proportion of people in power are those who lack empathy, perspective-taking, and the self-control necessary to put the brakes on aggressive and disruptive impulses.

Of course, not all people who support populism are antagonistic people. There are a number of reasons why people support populists. Sociologist Arlie Russell Hochschild has done a tremendous job trying to understand what many Trump voters were thinking when they cast their ballots. The reasons include "lives ripped apart by stagnant wages, a loss of home, an elusive American dream, and political choices and views that make sense in the context of their lives."

Nevertheless, there is a growing prominence of antagonistic people on social media, YouTube, and alternative media outlets who believe they have better answers than the government "elite" and are empowered and aroused by Trump's populism messaging to have more influence than ever before. Rather than socioeconomic factors being the most prominent explanation for the appeal of populism (Bakker and colleagues actually controlled for socioeconomic status in their studies), a critical reason why

people have become more receptive to populism is that people have become *better educated* and *more free* to speak their views in public. In fact, the appeal of populism is due, in part, to the increased egalitarianism of the 1960s, a consequence being that citizens today expect more from politicians, and feel more competent to judge their actions.

On the whole, this is a good thing. However, as Cas Mudde points out, more and more citizens think they have a good understanding of what politicians do and think they can do it better, while at the same time, less people actually *want* to do it better by actively participating in various aspects of political life. Political theorist Robert Dahl put it well when he wrote, "Nearly a half-century of surveys provides overwhelming evidence that citizens do not put much value on actually participating themselves in political life."

Interestingly enough, populist supporters don't actually want to be led by the "common person"; rather, they want their own values and wishes to be enacted by a "great" leader. Mudde has found that most populist leaders are actually "outsider-elites"; they are highly connected to the elites, but they are not *part* of the elites. Supporters of populism simply don't want to be governed by an "alien" elite, whose policies do not directly satisfy their own wishes and concerns.

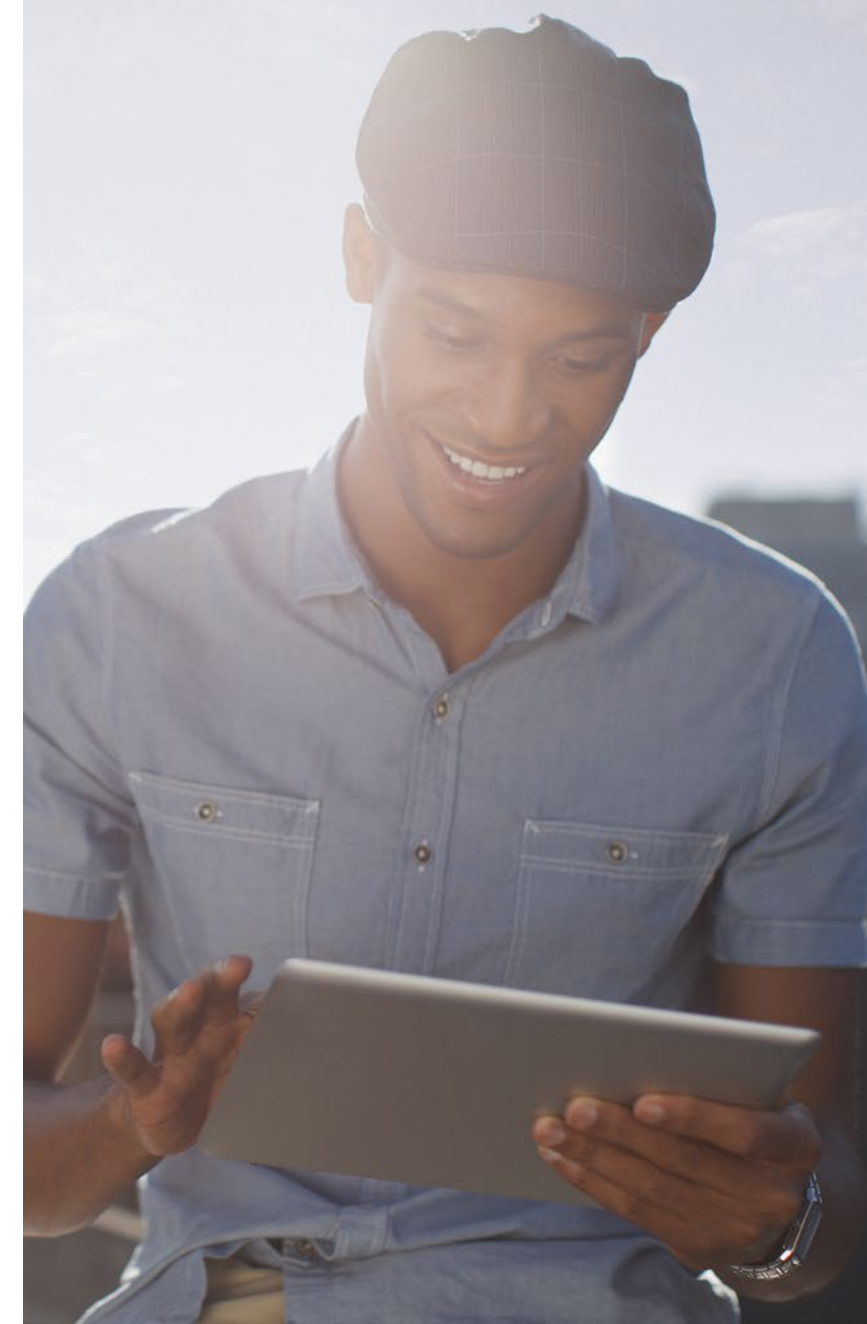
This research is important to keep in mind, as it looks like the use of populist rhetoric in the service of enacting more radical policies is not going away anytime soon. As Mudde observes, due to a number of factors, "populism will be a more regular feature of future democratic politics, erupting whenever significant sections of 'the silent majority' feels that 'the elite' no longer represents them."

Understanding differences in personality may not be the only factor involved in understanding the appeal of populism, but for the sake of the country and the world, it's an important one to consider. **M**

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Happy, with a 20 Percent Chance of Sadness

Researchers are developing wristbands and apps to predict moods—but the technology has pitfalls as well as promise

By Matt Kaplan

In the winter of 1994, a young man in his early twenties named Tim was a patient in a London psychiatric hospital. Despite a happy and energetic demeanor, Tim had bipolar disorder and had recently attempted suicide. During his stay, he became close with a visiting U.S. undergraduate psychology student called Matt. The two quickly bonded over their love of early-nineties hip-hop, and just before being discharged, Tim surprised his friend with a portrait that he had painted of him. Matt was deeply touched. But after returning to the United States with portrait in hand, he learned that Tim had ended his life by jumping off a bridge.

Matthew Nock now studies the psychology of self-harm at Harvard University. Even though more than two decades have passed since his time with Tim, the portrait still hangs in his office as a constant reminder of the need to develop a way to predict when people are likely to try and kill themselves. There are plenty of known risk factors for suicide—heavy alcohol use, depression and being male among them—but none serve as tell-tale signs of imminent suicidal thoughts. Nock thinks that he is getting close to solving that.

Since January 2016, he has been using wristbands and a phone application to study the behavior of consenting patients who are at risk of suicide, at Massachusetts General Hospital in Boston. And he has been running a similar trial at the nearby Franciscan Children's Hospital this year. So far, he says, although his results have not yet been published, the technology seems able to predict a day in advance, and with reasonable accuracy, when participants will report thinking of killing themselves.

Nock's trial is one effort to make use of the burgeoning science of mood forecasting: the idea that by continuous-

ly recording data from wearable sensors and mobile phones, it will be possible not only to track and perhaps identify signs of mental illness in a person, but even to predict when their well-being is about to dip. Nock collaborates with Rosalind Picard, an electrical engineer and computer scientist at the Massachusetts Institute of Technology. Picard leads a team that has tracked hundreds of undergraduates in universities in New England with phones and wristbands, and reports being able to predict episodes of sadness in these students a day before symptoms arrive.

Hints that it might be possible to track impending emotional vulnerability have sparked strong commercial interest. Mindstrong Health, a company in Palo Alto, Calif., which has raised U.S. \$29 million in venture capital, tracks how people tap, type and scroll on their phones, to spot shifts in neurocognitive function. Paul Dagum, a physician and computer scientist who founded the firm, says that data from a person's touchscreen interactions can identify oncoming episodes of depression, although that work has not yet been published. Oth-

er companies are also researching the use of such "digital phenotyping" to recognize symptoms of mental illness. Among them is Verily, a life-sciences firm owned by Google's parent company, Alphabet.

At this stage, the reliability of mood-prediction technology is unclear. Few results have been published, and groups that have released results say they have achieved only moderate rather than outstanding accuracy when it comes to forecasting moods. Picard, however, is confident that the concept will hold up. "I suffered from depression early in my career, and I do not want to go back there," she says. "I am certain that by tracking my behaviors with my phone I can make it far less likely I will return to that terrible place."

But researchers including Picard have reservations about possible downsides of their creations. They worry that scientists and clinicians haven't thought enough about how to inform users of an imminent emotional downturn. There are also questions about whether such warnings could cause harm. And some wonder whether corporations or insurance companies might use the technology to track the future mental health of their employees or customers. "The [potential for] misuse of this technology is what keeps me up at night," Dagum says.

PREDICTING DEPRESSION

Picard got into mood-prediction research indirectly. A decade ago, she showed that it was possible to use wristbands to detect seizures, sometimes minutes before spasms shook the body, by tracking the electrical conductance on a person's skin. In 2013, she co-founded Empatica, a company in Cambridge that sells sensors, including

a smartwatch approved by the U.S. Food and Drug Administration to monitor signs of seizures and issue alerts to caregivers.

Working with her PhD student at the time, Akane Sano, now at Rice University, Picard saw potential for wider applications. They hypothesized that it might be possible to combine data from wrist sensors and mobile phones to monitor stress, sleep, activity and social interactions to predict general mental health and well-being.

Sano and Picard collaborated with a team at Harvard Medical School to design a study that would track university students on a daily basis. Since 2013, the team has studied 300 students—50 each semester, for 30 days at a time—by giving them watch-like devices to wear. The instruments measure the students' movements, note the amount of light they are exposed to, monitor their body temperature and record the electrical conductance of their skin. Sano and Picard also developed software, installed on participants' phones, which records data about their calls, text messages, location, Internet use, "screen on" timing and social interactions. The team also recorded much of their e-mail activity. Students filled out surveys twice a day about their academic, extracurricular and exercise activities. They described their sleep quality, their mood, health, stress levels, social interactions and how many caffeinated and alcoholic drinks they were consuming. The students also reported their exam scores and filled out extensive surveys at the beginning and end of the 30-day studies.

By 2017, the team had reported training an algorithm to learn from these surveys and to weight the importance of hundreds of measurements. The system can accurately forecast, a day in advance, the students' happiness, calmness and health, Picard's team says. In the experiment, individuals had to be monitored for seven days to reach forecast-accuracy levels of around 80 percent.

Picard's analysis suggests that wristbands and mobile phones are not able to predict slight changes in mood. But when changes in well-being are large, predictions are more reliable. Some of the signals make intuitive sense—moving around before bed might suggest agitation, for instance—but the details are not always understood. As an example, social interactions might modify stress levels, which can be reflected in skin electrical conductance, but it's unclear whether many peaks of skin conductance in a day is good or bad, because it increases both when people are problem solving and when they are stressed.

Simply interpreting someone's mood using such signals is a great achievement, says computer scientist Louis-Philippe Morency at Carnegie Mellon University, who thinks artificial-intelligence technology could help with mental-health assessments. But he is cautious about its ability to forecast moods. "Since tomorrow's mood is often similar to today's mood, we need more research to be able to clearly decouple these two phenomena. It is possible that current forecasting technologies are mostly predicting spillover emotion from one day to the next," he says.

Picard thinks improvements will come: "We are the pioneers saying that this is truly possible and are showing data to back this claim up. Reliability will grow and grow with more data." She has made her algorithms open-source, so that others with access to the technology can try to reproduce her work.

"Picard is on to something, and her track record of transparency with her algorithms, models and data sets makes me even more confident of that. People don't make it so easy to recreate their work when they are unsure about their results," says Jonathan Gratch, a psychologist at the Institute for Creative Technologies at the University of Southern California.

Nock's trial on suicidal thoughts grew out of a collaboration with Picard. So far, he has monitored 192 people, mainly using wristbands and by asking them how they

are feeling, through a phone app or interview. For now, he has trained devices not on an individual's data, but on those of the entire group of participants, and he says that he has identified a few measurable signs that can predict later suicidal thoughts with an accuracy of 75 percent. Some of the most important factors, he says, are considerable movement in the evening, perhaps denoting restlessness or agitation at night, mixed with spikes in skin electrical conductance and an elevated heart rate. But he declined to give more details because his paper is under review at a journal.

MOVING TO MARKET

Commercial firms are less willing than are academics to discuss their results. But in March, Mindstrong reported finding digital biomarkers—patterns of swipes and taps on a phone—that correlate with scores on neuropsychological performance tests. On its Web site, the firm says it has completed five clinical trials, the results of which have not been disclosed, and in February, it announced a partnership with Tokyo-based Takeda Pharmaceuticals to explore the development of digital biomarkers for conditions such as schizophrenia and treatment-resistant depression. It has competition: Verily says its digital phenotyping projects include one designed to detect post-traumatic stress disorder using smartphones and watches.

Mindstrong says it's moving beyond measuring brain function with smartphones, to predicting it. "When we take in the trajectory of numerous biomarkers over the course of six or seven days, we can predict episodes of depression up to a week in the future," says Dagum—although he declined to say which signals his firm is using, because the company was submitting papers on its work to journals.

The plan for Mindstrong's phone-based app (the company is not using wristbands) is to embed its touchscreen-in-

teraction measures into a digital mental-health-care system. It has been sharing results with the state of California, which sees enough clinical potential to have granted the firm \$10 million over three years from a state-managed, \$60-million mental-health innovation fund. “Will all of these data that we are collecting ultimately have clinical utility? We don’t know yet,” says psychiatrist Tom Insel, who co-founded Mindstrong and had previously started the mental-health unit at Verily after a 13-year stint as head of the U.S. National Institute of Mental Health.

Picard questions Insel’s approach at Mindstrong. “I believe he has made a company with an idea that is not proven to work as well as other ideas,” she says. Neither she nor Nock yet have commercial plans for their mood-prediction technology. (Besides Empatica, however, Picard has co-founded Affectiva, a firm in Boston that sells technology to analyze facial and vocal expressions.)

Insel says the technology needs testing in real-world settings, with patients and health providers. “We are not running before walking. California is paying us to learn how to walk,” he says. He adds that he doesn’t view Picard as a rival. “This is a hard problem that no one has solved. My best guess is that it will take all of us using many approaches to prove the clinical value of this technology—and, frankly, I’d love to have at least 10 other groups of Roz’s lab’s caliber working on digital phenotyping,” he says.

CHANGING BEHAVIOR

Picard is confident that mood forecasting—even if it requires individualized training from a consenting user—will become a perfected art. The real question, she says, is whether it can be used to help change a forecasted dark mood.

Nock and psychologist Evan Kleiman, also at Harvard University, are working with 150 patients to encourage them to reappraise things that they are viewing negatively by using cognitive reframing exercises. These exercises

are activated on the patients’ phones when their wrist monitors detect signals that predict upcoming suicidal thoughts. Beyond this, Nock is unclear what to do with the data. “If we have someone who is predicted to be at high risk for suicidal thoughts, or who notes that they are 100 percent likely to kill themselves, what do we do? Do we send an ambulance? Contact their doctor? Do nothing?” he wonders. “The ethics of this are extremely challenging.” Nock says he knows that those in his trial want the technology. “Patients say all the time how useful they would find an alert or guidance system,” he says.

Morency thinks that it is too soon for computers to be giving mental-health advice on their own. His research involves teaching computers to study facial expressions and language so that they can work out what is on a person’s mind, and he is now collaborating with psychiatrists to install this technology in hospital mental-health wards. The goal is for machines to study people during their interactions with doctors, to discern whether psychiatric disorders are present. The physicians still do the diagnosis; the computer analysis provides a separate assessment that doctors can compare with their own. “The risks presented by a computer giving mental-health advice are significant. We need more research to understand the long-term impact of such technology,” Morency says.

Another issue, says Picard, is that actions to improve mood are different for different people. In one of her experiments, Picard found that one cluster of students who had conversations with friends before going to sleep enjoyed brighter moods the following day, whereas another cluster experienced the inverse effect.

Barbara Fredrickson, a psychologist at the University of North Carolina at Chapel Hill, is concerned that the act of predicting a mood could affect how people feel. “It seems likely that people will give negative mood forecasts a great deal of attention, and for some, this could start an emotional negativity tailspin that could be truly

damaging,” she says.

Justin Baker, a researcher in mental illnesses who is the scientific director of the McLean Institute for Technology in Psychiatry in Belmont, Mass., says: “I think it will be just as difficult for us to determine what advice a person needs as it will be to determine how to present that advice to them in a manner that does not get ignored or make them worse.”

Picard has grand visions for digital mood forecasting. She thinks it could improve the health of the general public, and in particular that it might benefit corporations. “Why do so many amazing companies that give their employees every perk under the sun still lose so many staff to depression? Can we catch the coming transition before it takes place?” she says. But she also worries that the technology might be misused. Picard thinks that new regulations might be needed to prevent, say, corporations from targeting advertising at those whose bad or good moods can be seen coming, or to keep insurance companies from setting prices based on signs of their customers’ mental health.

“A few bad actors who misuse this technology could spoil the benefits for patients with serious mental-health issues,” says Insel. Mindstrong, he says, is working with a bioethics group at Stanford University and plans to publish a paper on these matters shortly.

Picard argues the research efforts are worthwhile. “Clinical depression is often emotional death by a thousand cuts,” she says. “If we can help to identify the many little things that weigh us down over time and drive us into a perpetual sorrowful state, we can make a big difference.” **M**

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Dissecting the Bloodthirsty Bliss of Death Metal

Fans of this violent music report feelings of transcendence and positive emotions; psychologists want to learn why

By David Noonan

Cannibal Corpse

*Brutality now becomes my appetite
Violence is now a way of life
The sledge my tool to torture
As it pounds down on your forehead*

SHAKESPEARE IT'S NOT. THOSE LYRICS, FROM "Hammer Smashed Face" by the band Cannibal Corpse, are typical of death metal—a subgenre of heavy metal music that features images of extreme violence and the sonic equivalent of, well, a sledgehammer to the forehead.

The appeal of this marginal musical form, which clearly seems bent on assaulting the senses and violating even the lowest standards of taste, is mystifying to nonfans—which is one reason music psychologist William Forde Thompson was drawn to it. Thompson and his colleagues have published three papers about death metal and its fans this year, and several more are in the works.

"It's the paradox of enjoying a negative emotion that I was interested in," says Thompson, a professor at Macquarie University in Sydney, Australia. "Why are people interested in music that seems to induce a negative emotion, when in everyday life we tend to *avoid* situations that will induce a negative emotion?" A number of studies have explored the emotional appeal of sad music, Thompson notes. But relatively little research has examined the emotional effects of listening to music that is downright violent.

Thompson's work has produced some intriguing insights. The biggest surprise? "The ubiquitous stereo-

type of death metal fans—fans of music that contains violent themes and explicitly violent lyrics—[is] that they are angry people with violent tendencies," Thompson says. "What we are finding is that they are not angry people. They're not enjoying anger when they listen to the music, but they are in fact experiencing a range of *positive* emotions."

Those positive emotions, as reported by death metal fans in an online survey that Thompson and his team conducted, include feelings of empowerment, joy, peace and transcendence. So far, almost all of the anger and tension Thompson has documented in his death metal studies has been expressed by nonfans after listening to samples of the music.

In a paper entitled "Who Enjoys Listening to Violent Music and Why?," published earlier this year in *Psychology of Popular Media Culture*, Thompson and colleagues sought to identify specific personality traits that distinguished death metal fans from nonfans. In the study, which involved 48 self-described death metal fans and 97 nonfans (all in their 20s), he deployed an arsenal of established psychological tools and measures. These included the Big Five Inventory (BFI) of personality—which assesses openness to experience, conscientiousness, agreeableness and neuroticism—as well as the Interpersonal Reac-

David Noonan is a freelance writer specializing in science and medicine.

tivity Index (IRI), a 28-item measure of empathy.

Notably, on measures of conscientiousness and agreeableness, the scores of death metal fans were subtly but reliably lower than those of nonfans. One possible explanation for this finding, the authors write, "is that long-term, persistent exposure to violent media may lead to subtle changes in one's personality, desensitizing fans to violence and reinforcing negative social attitudes." But Thompson emphasizes that we just don't know. It is also possible that people with these personality traits are more likely to gravitate to death metal.

Results from the IRI showed the fan group and nonfan group with similar scores on the four dimensions of empathy that the index measures. When listening to death metal, however, study participants with lower empathy scores were more likely to experience higher levels of power and joy than those with greater empathic concern. That was true as well, Thompson found, for people whose personality assessment showed them to be more open to experience and less neurotic.

In the study, each participant listened to four out of eight 60-second samples of popular death metal songs (selected by the researchers from multiple online lists) and answered questions about the feelings the music evoked. The songs included "Slowly We Rot," by Obituary and "Waiting for the Screams," by Autopsy, as well as "Hammer Smashed Face."

In one set of responses, the subjects rated (on a scale of 1 to 7) the emotional effects of the music, using pre-selected terms such as "fear" and "wonder." In a second

step, they described in their own words how death metal made them feel. “With its repetitive, fast-paced tempo, down-tuned instruments and blast beats, it is virtually impossible not to be excited!” one fan wrote. “It sounds like messed-up teenagers making throaty, irritating noises about how bad their lives are,” wrote a nonfan. “It’s annoying.”

The fact that the study relies on self-reporting by the subjects is a red flag for Craig Anderson, a psychology professor at Iowa State University, who has spent his career researching the links between media violence and aggression and who was not involved in Thompson’s study. Self-reporting “may or may not reflect reality,” Anderson says. “People may be lying to you, or, more likely, people don’t have direct access to many of the kinds of effects that media have on them. They can construct an idea or hypothesis, and self-reports are essentially that kind of data. People may report that ‘Oh, yeah, this makes me feel this way,’ without recognizing whether that’s really true.”

The paper acknowledges the limitations of self-reporting. But the researchers add that “the convergence of evidence” from the personality assessments and other measures, along with the fans’ enthusiastic embrace of death metal, suggests that the dramatic differences in emotional and aesthetic responses between fans and nonfans are genuine.

Chris Povelis, a founding member and guitarist of the band Internal Bleeding (whose songs include “Gutted Human Sacrifice” and “The Pageantry of Savagery”), is confident that the positive emotions he experiences when he plays and listens to death metal are the real thing. “When I’m locked into it, it’s like there’s electricity flowing through me,” says the 50-year-old, who runs his own graphic design business. “I feel really alive, like hyper-alive. And the people I know in death metal are smart, creative and generally good-hearted souls.”

In an essay published in August in *Physics of Life*

Reviews, Thompson and his co-author Kirk Olsen considered the possible role of brain chemistry in the response to violence and aggression in music. The high amplitude, fast tempo and other discordant traits of death metal, they write, may elicit the release of neurochemicals such as epinephrine—which “may underpin feelings of positive energy and power reported by fans, and tension, fear and anger reported by nonfans.”

As for the central riddle of death metal—how explicitly violent music might trigger positive emotions in some people—Thompson cites a [2017 paper](#) on the enjoyment of negative emotions in art reception, published in *Behavioral and Brain Sciences*. The paper, from the Max Planck Institute for Empirical Aesthetics, suggests a mental process that combines “psychological distancing” and “psychological embracing.” In other words, a lack of real-world consequences—it’s just a song!—may provide the *distance* necessary for fans to appreciate the music as an art form and *embrace* it.

A large body of research, by Anderson and others, has established a clear link between aggression and multiple types of media violence, including video games, film, television and music with violent images and themes. “But no one is saying that a normal, well-adjusted person—who has almost no other risk factors for violent behavior—is going to become a violent criminal offender simply because of their media habits,” says Anderson, whose research includes a [2003 study](#) of the effect of songs with violent lyrics. “That never happens with just one risk factor, and we know of dozens of common risk factors. Media violence happens to be one.”

One finding from Thompson’s research—that many death metal fans say they listen to the music as a catharsis, a way to release negative emotions and focus on something that they enjoy—is also familiar to Povelis. “I call it the garbage can,” he says of the music he’s been involved with for decades, “because it’s where I can dump

all my bad, emotional baggage. I put it into writing riffs and letting it all out on stage, and it keeps me level and completely sane.”

In his ongoing study of violent and aggressive music, which includes a [June paper](#) in the journal *Music Perception* about the intelligibility of death metal lyrics (forget about it, nonfans), Thompson has found that the limited appeal of the form may be one of its key features for fans—one at least as old as rock itself. He cites a [2006 paper](#) by the late Karen Bettez Halnon, who found that fans of heavy metal (as has certainly been the case with many other genres and sub-genres over the decades) view the music as an alternative to the “impersonal, conformist, superficial and numbing realities of commercialism.”

In that vein, one possible function of the gruesome lyrics that are the hallmark of death metal, says Thompson, may be to “sharpen the boundary” between fans and everybody else. Povelis, who compares the violent imagery to the “over-the-top, schlock horror films of the ’70s,” says feeling like an outsider and an insider at the same time is at the core of the death metal experience. “This music is so extreme and so on the fringe of the mainstream that people who listen to it and people who play in death metal bands belong to an elite club. It’s like we’ve got a little secret, and I think that’s what binds it all. It’s a badge of honor.” **M**



Post-traumatic Stress Disorder Can Be Contagious

PTSD sometimes spreads from trauma victims to the people who care for them, including rescue workers, spouses and even therapists

By Christian Wolf

Christian Wolf is a science journalist based in Berlin.

For years he was tortured by a horrifying image of 9/11: elevator doors at the World Trade Center slide open, and burning people stumble out; screams fill the area. Except he was not at the World Trade Center that day. A clinical psychologist, he had treated several patients who were there and suffered post-traumatic stress disorder (PTSD) as a result, unable to rid themselves of the terrifying memories. Over the course of long, tortured conversations, these memories etched themselves indelibly into his own mind. They intruded on everyday situations and turned up in nightmares. For the first time in his life he had panic attacks.

And he is by no means alone. In the past several years it has become evident that therapists, emergency personnel, the police and family members who deal with traumatized individuals can develop symptoms of PTSD secondhand. They endure what are called intrusions—images, flashbacks and nightmares that cause them to experience the horrible events over and over—even though the memories are not their own. Like people

who have themselves been terrorized, they live in a state of stress-induced hyperarousal, with an overly active fight-or-flight response. They may suffer from sleep disorders and feel utterly hopeless.

The most recent edition of the *Diagnostic and Statistical Manual of Mental Disorders* acknowledges the problem. A diagnosis of PTSD no longer requires the *immediate* experience of a traumatic event; a person need not have been a victim or even an eyewitness. It is enough simply to hear the details. Recent research has begun to clarify how common the problem is and why some people are more susceptible to it than others.

YOUR STRESS IS MY STRESS

The collected research suggests that 10 to 20 percent of people closely involved with those who have PTSD “catch” the condition themselves—with the numbers varying depending on the study and the group being investigated (such as therapists, social workers or family members). In 2013, for instance, a team led by Roman

Cieslak of the Trauma, Health, and Hazards Center at the University of Colorado Colorado Springs Medical Campus found that almost one in five of more than 200 health care providers helping military personnel with PTSD met the criteria for “secondary trauma,” one name that researchers apply to the phenomenon.

A follow-up analysis concluded that the providers had about as many symptoms, such as intrusions, as rescue personnel or social workers who had been at the scene at the time. And according to psychologist Tamara Thomsen of the University of Hildesheim in Germany and her colleagues, one in five of approximately 300 trauma therapists who responded to an online questionnaire could be diagnosed with moderate secondary trauma—and one in 10 with severe secondary trauma.

In several studies involving family members, Israeli trauma researcher Zahava Solomon of Tel Aviv University found that a percentage of the wives of former prisoners of war could be diagnosed with indirect trauma. A 2017 review that included parents and children of war veterans, as well as committed partners, paints a more inconsistent picture, though: the partners were affected most frequently; parents seemed not to have been “infected”; and children sometimes exhibited symptoms, although they were not especially severe.

How is it that PTSD can be transmitted to caregivers or family members? At first glance it would seem quite remarkable that the sensory experiences of one person can end up in another person’s head. “In contrast to the victims of primary trauma, there is no *direct* input from the sensory organs that might be saved in memory in

IN BRIEF

When caregivers, rescue workers or family members attend to someone with post-traumatic stress disorder who has suffered a horrible experience, a number of them develop “secondary” PTSD, without themselves having witnessed the traumatic event.

Stories of trauma, it seems, can become etched into memory as if they were the hearer’s own experiences. This memory transfer may occur because the brain regions that process real and imagined experiences overlap considerably.

The more that caregivers or family members empathize with a victim and the less able they are to maintain emotional distance, the more likely it is that they will experience secondary trauma.

the brain,” observes psychologist Judith Daniels of the University of Groningen in the Netherlands. “There are only images.” But she has a possible explanation: “The regions of the brain that processes visual imagery have a very strong overlap with regions that process imagined visual experience.” In other words, at the processing level it may make little difference to the brain whether the images were created by the eyes and optic nerve or by the powers of imagination. “If this is how the processing works, then both may lead to visual intrusions,” she says.

WHO IS MOST SUSCEPTIBLE?

Another puzzle is why many therapists, caregivers and family members do not succumb to secondhand PTSD, whereas others do. Work by Thomsen’s group suggests that a strong capacity for empathy—the ability to identify with the feelings of others—may increase the risk of secondary trauma. In following up with their questionnaire respondents a year and a half later, Thomsen notes, the researchers found that therapists “who exhibited greater emotional empathy were more apt to experience secondary trauma at the time of follow-up.”

For family members of trauma victims, a lack of emotional distance may also contribute, as is suggested by the finding that wives of former prisoners of war are more vulnerable to indirect trauma if they identify with their husband and internalize his traumatic experiences.

Researchers are also pondering the possible role of earlier trauma in susceptibility to secondary PTSD, theorizing that the symptoms may represent the reawakening of a prior, primary trauma. Some even doubt that symptoms occur in the absence of earlier primary trauma. In this reawakening scheme, trauma can add up over a lifetime, with each additional episode increasing the risk of PTSD. Hearing about the traumatic experiences of another person may become the straw that breaks the camel’s back.

To Thomsen, this notion implies that it may be import-

ant to figure out whether symptoms in a given therapist reflect secondary trauma or retraumatization. Daniels, however, finds it implausible that personally experienced trauma could by itself account for indirect PTSD. As evidence, she points to a meta-analysis by Jennifer Hensel, then at the University of Toronto, and her colleagues. The analysis found only a slight relation between personally experienced trauma and development of secondary trauma, which implies that past history probably explains only a small portion of the intensity of someone’s symptoms. “So it’s not nothing, but it is far from an adequate explanation for how these symptoms arise,” Daniels says.

In Daniels’s research with therapists, she stumbled on another risk factor: the dissociative processing of stories. In other words, therapists may detach while a patient relates disturbing events, experiencing the world as unreal and dreamlike. Dissociation, Daniels explains, could encourage indirect trauma because memory traces form differently when someone is in this state. When therapists dissociate while listening to a patient, they store little information about when and where the event took place and are less able to distinguish between themselves and the patient. As a result, they may later remember the threat as an actual danger experienced directly.

This last insight implies that we may have at least some control over the extent to which hearing or reading about traumatic experiences has a long-term effect on our psyche. Some preliminary findings indicate, for example, that focusing on positive aspects, such as the healing process, in conversations with a patient may help a therapist or caregiver keep some needed emotional distance. Those who cannot maintain a healthy distance may eventually take a patient’s horrible memories home with them—and become patients themselves. **M**

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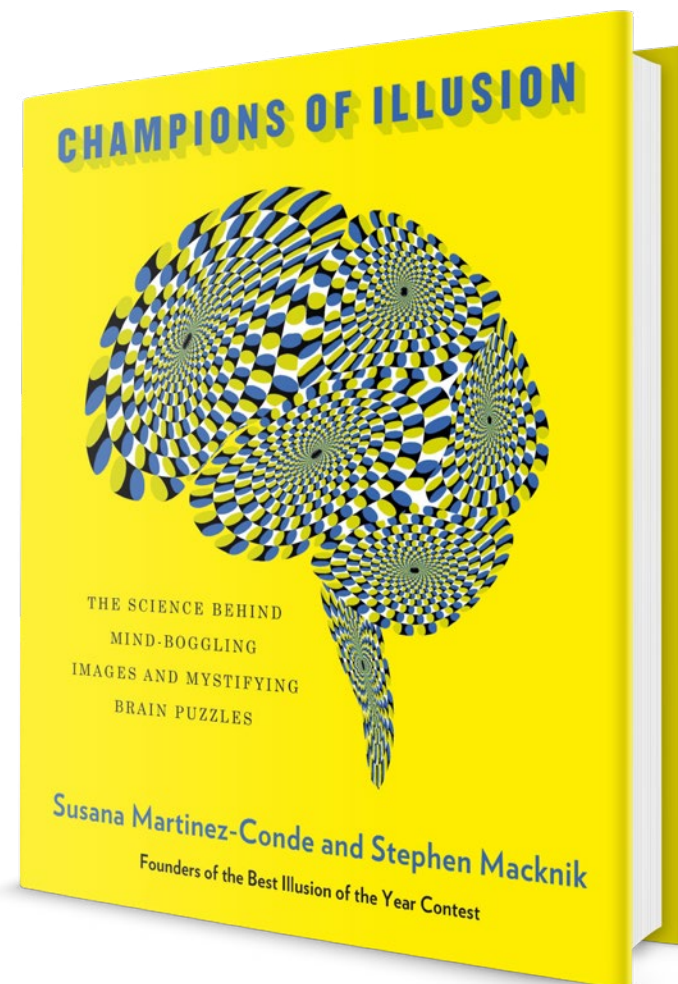
The New Champions of Illusion

An excerpt from a new book on visual illusions • *By Susana Martinez-Conde and Stephen Macknik*

What are visual illusions? Some people think illusions are simply mistakes made by the brain: erroneous computations, failures of perception that we would do well to overcome. But what if illusions are good things? Could it be that these peculiar mismatches between the inner and outer worlds are somehow desirable? Certainly, illusions are the product of evolution; we know that several illusions occur because of shortcuts that your brain takes to help you survive and thrive. Some of your misperceptions allow you to make lightning-fast assumptions that are technically wrong but helpful in practice. They can help you see the forest better—even if they make you discern the trees less precisely.

For example, you may underestimate or overestimate distances depending on various contextual cues. The psychologists Russell E. Jackson and Lawrence K. Cormack reported that when observers guessed the height of a cliff while looking down from the top, their estimates were 32 percent greater than when they were looking up from the cliff's base. This discrepancy appears related to the way we observe the same precipice from above versus below: a vertiginous cliff edge falling away from us versus a cliff face sloping into open land. Given that accidents are more likely to happen while climbing down rather than up, this height overestimation, when you look down from the top, may make you descend cliffs with greater care, reducing your chances of falling.

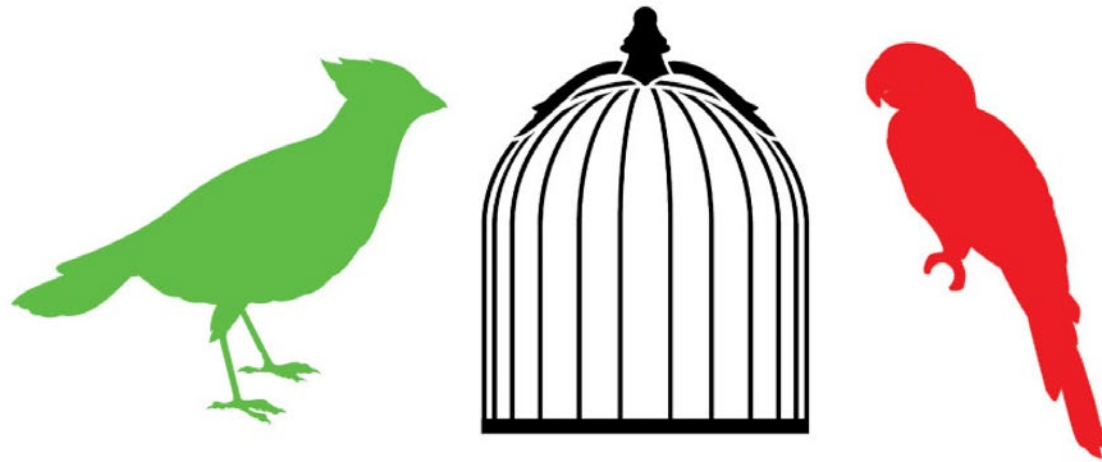
Illusions also offer a window into how our neural circuits create our subjective experience of the world. The simulated reality your brain creates—



also known as your consciousness— becomes the universe in which you live. It is the only thing you have ever perceived. Your brain uses partial and flawed information to build this mind model and relies on quirky neural algorithms to alleviate those flaws.

Because illusions enable us to see objects and events that do not match physical reality, they are critically important to understanding the neural mechanisms of perception and cognition. They expose the structure that our mental universe is based on. To encourage the discovery and study of illusions, we created the annual Best Illusion of the Year Contest in 2005 to honor the best new illusions from the previous year and celebrate the inventiveness of illusion creators around the world: researchers, software engineers, mathematicians, magicians, graphic designers, sculptors, and painters fascinated with mapping the boundaries of human perception. The contest is playful, but for scientists it serves a deeper purpose.

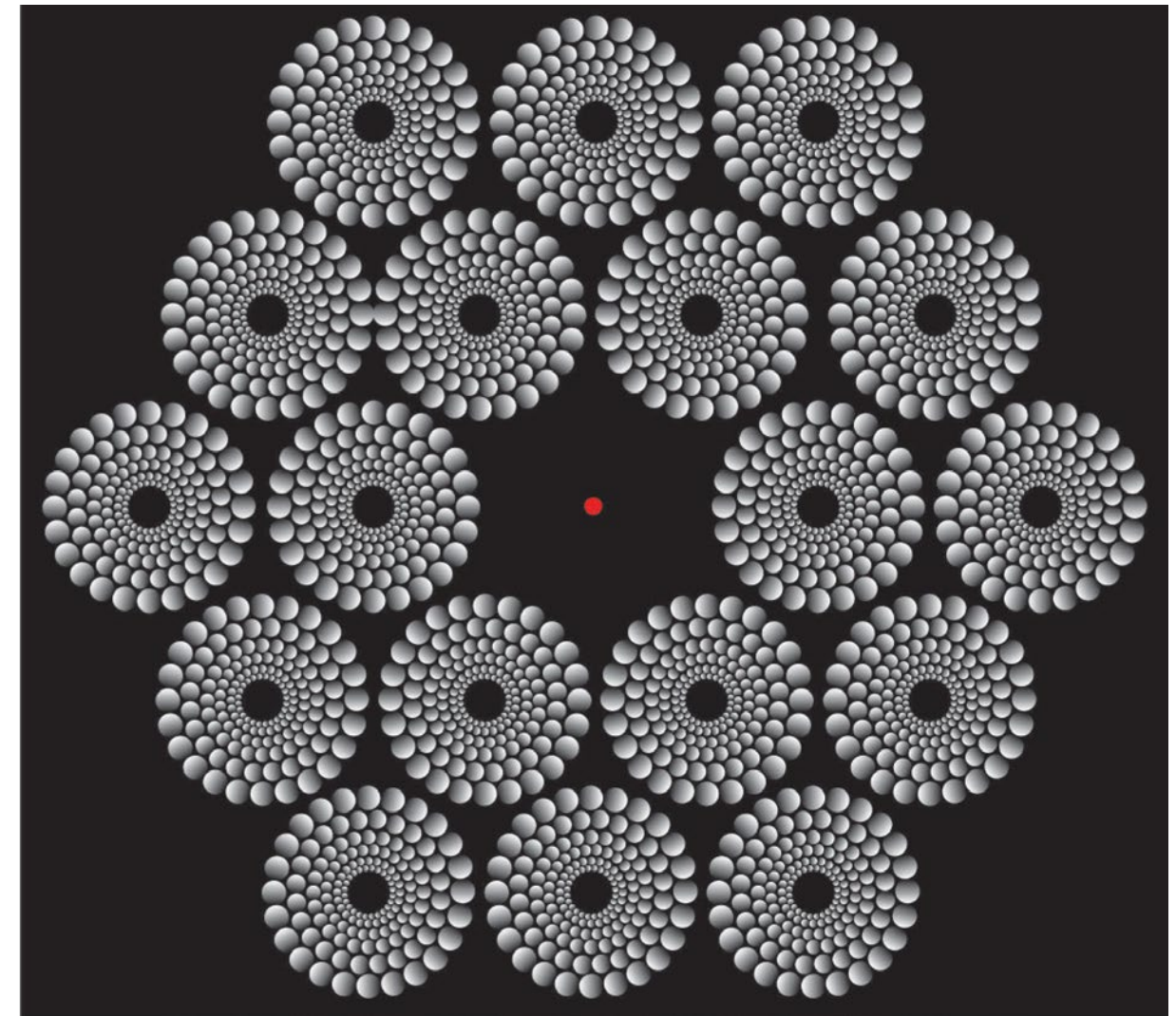
All the little perceptual hiccups that the contest showcases are opportunities to peer behind the neurological curtain and learn how the brain works. The contest has become an annual point of convergence for visual artists and scientists, and an event that illusion creators of all backgrounds look forward to, and prepare to compete in, every year. We have been particularly thrilled that the contest has spurred the creation and dissemination of new illusions that might otherwise remain undiscovered and unknown. The following illusions are contest winners featured in our latest book *Champions of Illusion*.



Birds in a Cage

By Martinez-Conde and Macknik Laboratories

When you stare at a color image, its afterimage takes on a shade of its own. Afterimages are the consequence of a neural process called adaptation, by which neurons decrease their responses to unchanging sensory inputs. Once neurons have adapted, it takes a while for them to reset to their previous, responsive state. It is during this period that illusory afterimages appear. We see such images every day when we experience a temporary dark spot in our field of vision after briefly looking at the sun or at a bright lightbulb, or after being momentarily blinded by a camera flash. Gazing at any colored surface can also induce a vivid afterimage of the complementary color—that is, red versus green, or blue versus yellow. Imagine staring at a red surface. The cells in your retina that respond to red light will reduce their activity to save energy and to prepare themselves for detecting any future changes in redness. So, when you look away to a white background, your retina remains adapted to the red environment for a few seconds. With the red “subtracted” from the white, you will see red’s opposite: green. To try it out, stare at the red parrot for 30 seconds, then immediately look at the center of the empty birdcage. You should see a ghostly greenish parrot inside. Try the same with the green cardinal, and you should see a pink bird. A similar illusion is part of an exhibit at the Exploratorium museum in San Francisco.



The Spinning Disks Illusion

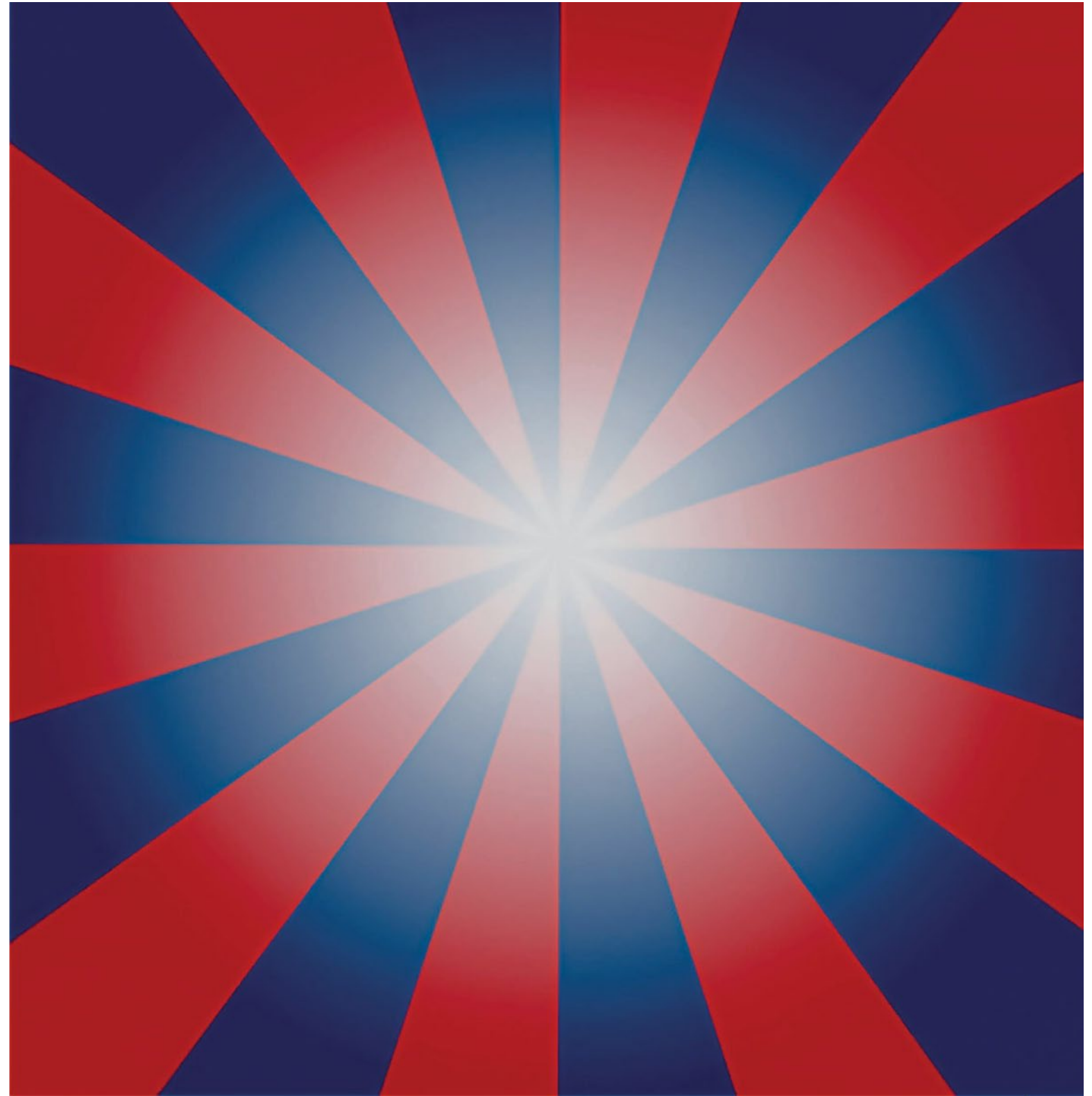
By Johannes Zanker
Royal Holloway, University of London
2005 finalist

In the Spinning Disks Illusion, grayscale gradients in the shape of disks are arranged in concentric circles that seem to spin slowly, instead of appearing completely motionless—which they actually are! The illusion is caused by involuntary eye movements: each eye motion moves the image onto a new population of retinal photoreceptors. If you stare at the red central dot, carefully holding your eyes in place, the illusory motion will cease.

Here Comes the Sun

By Alan Stubbs
University of Maine
2006 finalist

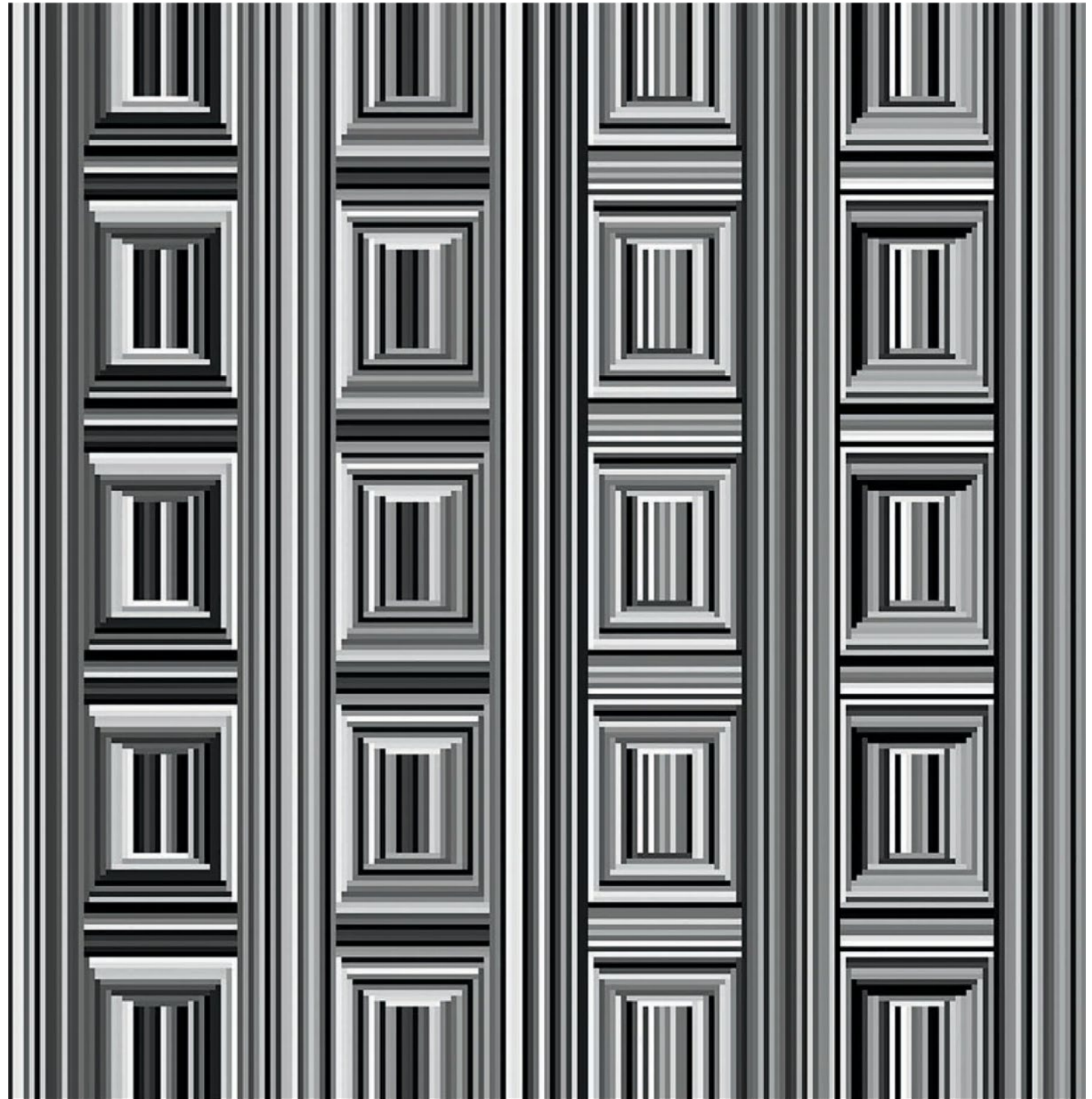
Hold this book at a comfortable distance from your eyes while looking at the picture. Then bring the book gradually closer. As the image approaches, you should notice that its brightness seems to increase. Move the book back and forth to make the brightness increase and decrease repeatedly. The neural bases of this effect are not yet understood, but the explanation may reside in how our visual system reacts to expanding versus contracting objects as a function of their distance from the observer. Some motion-sensitive neurons of the visual pathway become selectively activated when visual objects either loom (expand) or recede (contract). It could be that the ghostly, transparent white cloud radiating from the center of the image appears less salient to those neurons than the highly visible red-blue background. If so, when the cloud and the background expand and contract together, your neurons may signal a difference in the relative amounts of expansion and contraction—so that one element appears to loom or recede more than the other, even though no difference actually exists.



The Coffer Illusion

By Anthony Norcia
Smith-Kettlewell Eye Research Institute
2007 finalist

Information transmitted from the retina to the brain is constrained by physical limitations, such as the number of nerve fibers in the optic nerve (about a million wires). If each of these fibers were responsible for producing a pixel (a single point in a digital image), you should have lower resolution in your everyday vision than in the images from your iPhone camera, but of course this is not what we perceive. One way our visual system overcomes these limitations—to present us with the perception of a fully realized world, despite the fundamental truth that our retinas are low-resolution imaging devices—is by disregarding redundant features in objects and scenes. Our brains preferentially extract, emphasize, and process those unique components that are critical to identifying an object. Sharp discontinuities in the contours of an object, such as corners, are less redundant—and therefore more critical to vision—because they contain more information than straight edges or soft curves. The perceptual result is that corners are more salient than non-corners. The Coffer Illusion contains 16 circles that are invisible at first sight, obscured by the rectilinear shapes in the pattern. The illusion may be due, at least in part, to the human brain's preoccupation with corners and angles.



Brett Frischmann is the Charles Widger Endowed University Professor in Law, Business and Economics at Villanova University. His latest book is *Re-Engineering Humanity* (Cambridge University Press 2018).

● *Opinion*

OBSERVATIONS

There's Nothing Wrong with Being a Luddite

It enables critical reflection and evaluation of the technological world we're building

I was recently called a Luddite. It was meant to be an insult, to suggest that I was an anti-technology zealot. I resisted the temptation to defend my pro-tech cred and instead explained the importance of Luddites as a counterbalance to smart-tech utopianism.

Traditional Luddism involves "breaking technology" or refusing "to participate in sociotechnical systems." Why bother? For some, it's political resistance to disruptive technological innovation that threatens an existing way of life. For others, it's an ethical response to the ways in which the technology affects personal or social relationships. In 1977, Langdon Winner went further and defended "epistemological Luddism," which involved decommissioning, dismantling or withdrawing from a sociotechnical system to learn about it and, more importantly, about how it affects individuals and society.

The good thing about Luddism is that enables



critical reflection and evaluation of the world we have built and are building. At times, we need to break away, to deconstruct the systems within which we find ourselves embedded and to evaluate how the technologies we take for granted influence who we are and can be. This is why some Luddism is important for society.

We all should practice some Luddism in our lives.

I am not saying we should destroy the IT systems at work and insist that everyone write memos in cursive on yellow notepads or etch them into stone tablets. That isn't what Luddism involves anyway. I'm calling for people to exercise their freedom to be off and while doing so, to reflect on and evaluate their relationships to the digital networked technologies they put aside or left behind.

Digital detox, as some have called it, can be a powerful eye-opener, provided one is open to reflecting on the experience. According to Michael Lachney and Taylor Dotson in their [recent paper](#) in *Social Epistemology*, after recovering from device withdrawal, detoxers begin to recognize the “substantial patterning influence [digital tech has] on the character of everyday life.” Digital detox can be a powerful means for individuals to reevaluate their relationships with digital tech.

But implicit throughout their discussion is the idea that there is a practically exercisable freedom to be a Luddite. It is worth considering what the structural preconditions for such a freedom might be.

Power and environmental conditions matter. As Lachney and Dotson acknowledge, “Rarely do individuals have any substantive say regarding which technologies come to shape their lives; they act within larger sociotechnical structures not of their own choosing.” People may choose brands and features and celebrate the modern consumerist cornucopia e-commerce delivers, but autonomy often falters when people consider withdrawal.

Modern society demands constant connection and participation, which makes practicing Luddism increasingly difficult. Forgoing Facebook invites social isolation; leaving messages untended risks frustrating bosses, spouses and, well, everyone else; being disconnected means missing out and being out of sync with fast-moving memes and social discourse. It is, of course, notoriously difficult to evaluate empirically the degree to which social pressures determine tech adoption and use.

The technological and social often seem insepara-

Whether and how society can sustain our freedom to be off is one of the foundational, constitutional questions of the 21st century.

ble. This is why Evan Selinger and I focus on techno-social engineering of humans in *Re-Engineering Humanity*. The “always on” world we’re building involves techno-social engineering of both our lived-in and experienced environments and our humanity, simultaneously. Who we are and are capable of being is inextricably intertwined with our built world. Thus, to protect Luddism, we need to engineer environments that sustain our freedom to escape or to be off.

Note that being a Luddite does not mean abandoning digital tech cold turkey. It is easy to tell people to just stop using this or that tech. Delete Facebook. Stop using GPS. Abandon your smartphone. (Or at least leave it in the charging station in the living room at night, please? That’s my household rule.) But for many people, much of the time, these suggestions are not practical given their current lifestyles and a host of economic, cultural and technological dependencies.

In the wake of the recent Facebook scandals,

including the Cambridge Analytica debacle, a movement to delete Facebook accounts has gained some traction. While some folks enjoy the freedom to do so, many simply do not. Perhaps thousands or even a hundred thousand people will delete their Facebook accounts, but the overwhelming majority of active Facebook users will not because they cannot, at least not yet.

Many depend on Facebook to maintain connections with family and friends, to organize events, to interact with co-workers, and so on. Until alternatives for accomplishing those ends are available and people see and experience how they can get on without the tech they currently depend on, quitting cold turkey just isn’t going to happen. Extreme prescriptions make for good media and may sell books, but [deletion isn’t a serious solution](#).

Digital tech companies are marketing their own “solutions”—for example, Apple’s Screen Time in iOS 12, Google’s Digital Wellbeing for Android, and hundreds of productivity apps designed to help us curb smartphone addiction. Their basic mantra that “there’s an app for that” naively assumes and perpetuates the erroneous but comforting belief that our problems are fundamentally computational problems for which more data and better algorithms is the best solution. This digital tech solutionism only reinforces our dependence on supposedly smart tech; we remain always on—whether using the smartphone normally or using the self-management app.

If you think you need an app to notify you that you’re overusing your smartphone, think again. Don’t give up on your own observational and social capabilities; there are plenty of social cues to pay attention to.

And don't give up on your social ties. Friends, family members, and co-workers likely will understand and hopefully join you. After all, you'll need their help to deal with the social pressures.

We need digital tech to be part of the solution, for example, by eliminating addictive design practices, shifting business models away from surveillance capitalism, and even engineering friction into some of our human-computer interactions. But outsourcing Luddism to the digital tech industry is oxymoronic.

We need Luddism to thrive, but it depends upon how we engineer our built environment and whether we sustain our freedom to be off. Always-on digital tech puts that freedom in general and Luddism in particular at risk. In short, we need to leave room for Luddites.

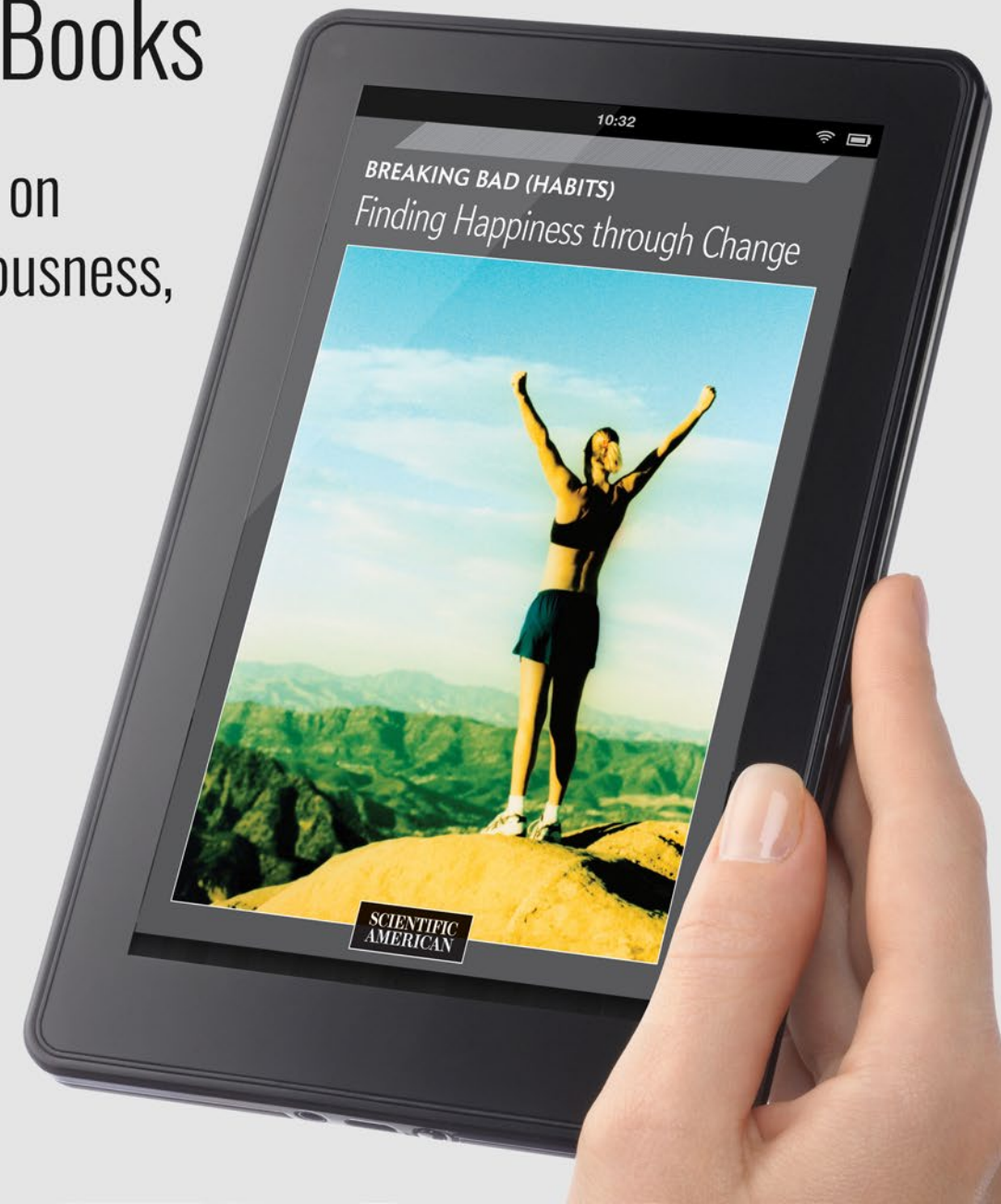
Whether and how society can sustain our freedom to be off is one of the foundational, constitutional questions of the 21st century. Ironically, such freedom must be engineered into the techno-social environment. We need reflexive detoxification to begin understanding how technology affects our humanity. We need baselines and evaluation both on and off the various technologies we use. The "always on" nature of supposedly smart sociotechnical systems may deprive us of the opportunity to practice or even entertain the possible value of practicing Luddism.

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Cindi May is a professor of psychology at the College of Charleston. She explores avenues for improving cognitive function in college students, older adults and individuals with intellectual disabilities. She is also an advocate for inclusive opportunities for people with disabilities.

BEHAVIOR & SOCIETY

Life Advice: Don't Find Your Passion

Study suggests meaningful work can be something you grow into, not something you discover

As a college professor, I have the privilege of advising young women and men as they make decisions about course selections, major areas of study, and life directions. Like other college students around the country, many of my advisees are searching for content they find interesting and meaningful, for work that is fulfilling and purposeful. Many are eager to “find their passion.”

On the surface, these goals seem laudable. Instead of seeking power, status or personal wealth, some students are motivated to discover their interests and uncover the path that excites and drives them. They want a career that lights their fire. Presumably they are adhering to the adage, “Do what you love and you’ll never work a day in your life.”

Recent research by investigators at Yale and Stanford, however, suggests this approach might be a



mistake. Rather than seek the one job or career path that ignites our passion, we should invest meaningfully in different interests and work to cultivate a passion in one or more fields. By this view, interests are nurtured over time, not discovered overnight.

The key here is mindset. Some people adopt a

“fixed mindset” approach and search for the one, predestined match in their lives. They expect this match to be enduring, full of excitement, and endlessly fulfilling. Fixed mindsets have been observed with romantic relationships and intelligence. Individuals with “destiny” mindsets about romantic relationships often

seek “the one,” and tend to move on when faced with relationship challenges. Individuals with fixed mindsets of intelligence believe that intelligence derives from a fixed talent and cannot be cultivated or nurtured through experience. Across all these domains, fixed mindsets tend to eschew the notion that exploration and resilience can lead to positive change.

A fixed mindset about interests can be limiting in two ways. First, it implies that our interests and talents may be narrow or specific. Once we find a path that intrigues us and brings success, we may curb or even abandon exploration of other potential interests. Second, we may expect pursuit of our one true passion to be easy—after all, this is the pathway that will provide endless drive and excitement, and will yield the greatest achievement. Consequently, instead of demonstrating resilience and perseverance in pursuit of this passion, we may fold when faced with failure or significant challenge. Difficulty may be perceived as indication that we are simply on the wrong path.

By contrast, individuals with a “growth mindset” believe that interests or passions can be developed or cultivated through experience, investment, and struggle. There is not a single, “right” path to be discovered or revealed; instead, many different interests are viable, even simultaneously. With a growth mindset, success in one arena doesn’t preclude or limit exploration of other interests, nor does difficulty signal the need to change course.

Evidence from five experiments demonstrates that mindsets significantly influence what we expect to happen when pursuing our interests and how we respond to new possibilities and challenges. In one study, researchers first determined whether partici-

pants had a fixed or growth mindset about interests using a simple questionnaire. This survey gauged the extent to which individuals perceived interests to be permanent, steadfast and static (fixed mindset), or malleable, flexible and dynamic (growth mindset). Participants then gave answers to several open-ended questions concerning their expectations about outcomes when pursuing a passionate interest. Relative to participants who expressed a growth mindset about interests, those who expressed a fixed mindset were far more likely to expect endless motivation and minimal struggle when pursuing a confirmed passion.

Additional studies demonstrated that mindset influences more than expectations; mindset changes behavior. In one paradigm, participants read two different articles, one that matched their personal goals and pursuits, and one that did not. Participants rated their interest in each article. When the article content matched participants’ pursuits, having a fixed versus growth mindset did not matter; everyone found the matching article interesting. When the article content mismatched participants’ pursuits, those with a fixed mindset reported far less interest in the material than those with a growth mindset. In other words, a fixed mindset diminished curiosity about topics not directly relevant to one’s primary pursuit.

Mindset also affected outcomes in the face of difficulty. In a final study, participants first watched a popular science film clip about black holes, and rated their interest in the clip. Most found it fascinating. Those expressing high interest in black holes after viewing the film then read a complex technical report on black holes. They rated both how difficult and how interesting they found the report. Among those who

found the technical report difficult to read, those with a fixed mindset subsequently expressed far less interest in black holes than those with a growth mindset. These findings suggest that when individuals with a fixed mindset pursue an emerging interest, they are more likely to lose interest in that topic if it becomes challenging.

On the bright side, a fixed mindset about interests may have its benefits. It may foster a single-mindedness that reduces distraction and promotes completion of a task. Assuming an individual faces minimal frustration when pursuing a passion, a fixed mindset may promote contentment and prevent endless consideration of alternative interests.

A fixed mindset about interests is likely to be a hazard, however, when advances within one’s field require the integration of broad and diverse knowledge sets, or when resilience is needed in facing new hurdles. For these reasons, college students would be wise to enroll in a variety of courses and to seek an array of experiential learning opportunities, including those that stretch them out of their comfort zones. Rather than searching for their one true passion, they should understand that interests, expertise, and even passion can be cultivated through experience, persistence, and hard work.

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