

SCIENTIFIC AMERICAN **MIND**

PLUS

THE PROBLEM
WITH IMPLICIT
BIAS TRAINING

EMOTIONAL LABOR
AND THE PANDEMIC

HOW TOPOGRAPHY
SHAPES PERSONALITY

Living Your Best Life

It doesn't depend on wealth,
or even constant happiness,
but a rich and complex experience

WITH COVERAGE FROM
nature

FROM
THE
EDITOR

LIZ TORMES



SCIENTIFIC
AMERICAN
MIND

Your Opinion Matters!

Help shape the future of this digital magazine. Let us know what you think of the stories within these pages by emailing us: editors@sciam.com.

That Thoroughly-Used-Up Kind of Life

Is there anything more American than the pursuit of happiness? Not merely written into the Declaration of Independence, it seems to be one of the more important metrics by which we measure our progress through life. In 2016 I remember reading a fascinating article on Vox.com by Ruth Whippman, a British writer, who made an intriguing observation after having lived in both countries. Americans' obsession with being happy, and our many efforts to achieve it, she wrote, was in fact making us miserable. Some interesting research backs up the idea that the more you value happiness, the less happy you are.

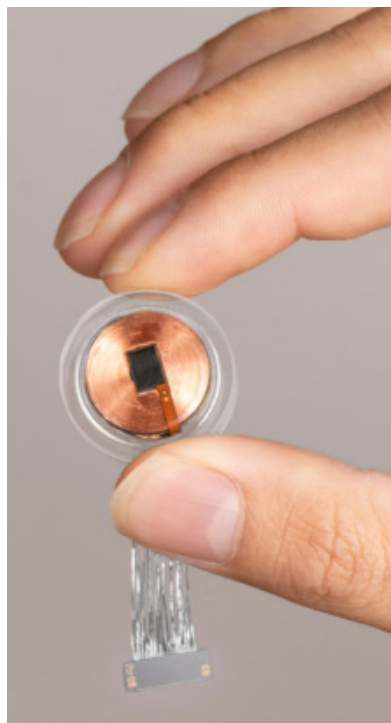
In this issue's cover story, Scott Barry Kaufman explores how a psychologically rich life, not necessarily a happy one, might yield a higher return on investment, so to speak. If emotional growth is of value to you, a wide range of feelings, challenges and experiences—even bad ones—might give you the good life you've been seeking (see "[In Defense of the Psychologically Rich Life](#)"). This is a comforting concept during a time of so much challenge and uncertainty. And it reminds me of a quote from journalist Hunter S. Thompson: "Life should not be a journey to the grave with the intention of arriving safely in a pretty and well preserved body, but rather to skid in broadside in a cloud of smoke, thoroughly used up, totally worn out, and loudly proclaiming " 'Wow! What a Ride!' "

Andrea Gawrylewski
Senior Editor, Collections
editors@sciam.com

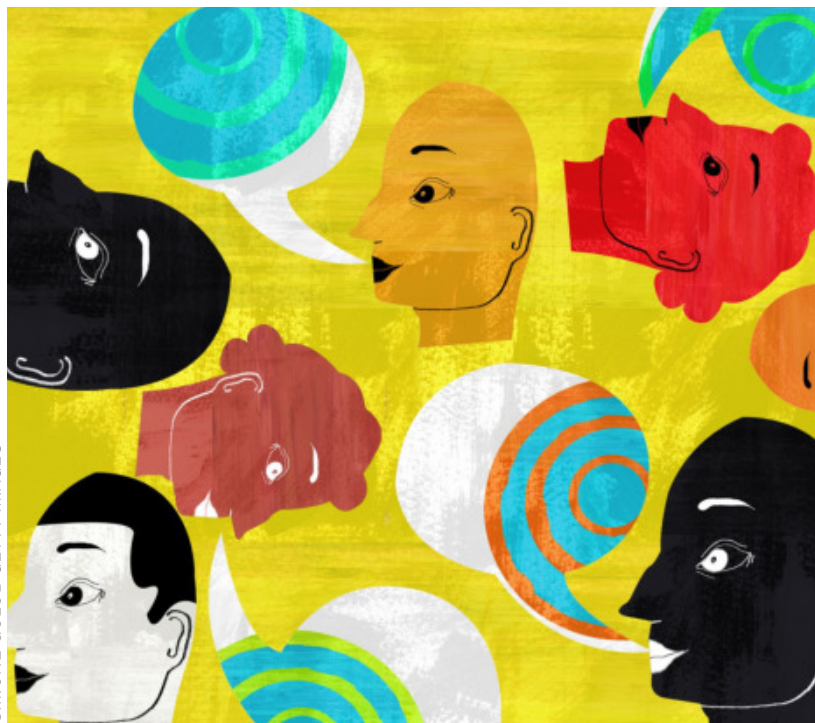


On the Cover

Living your best life doesn't depend on wealth, or even happiness, but a rich and complex experience



NEURALINK



SIMONE GOLOB GETTY IMAGES



PAUL MCGEE GETTY IMAGES



NICOLA KATIE GETTY IMAGES

NEWS

4. Mountain Peaks Seem to Shape Personality Traits in the American West

Topography may contribute to the formation of regional temperament

6. Cracking the Neural Code with Phantom Smells

Scientists used light to evoke an odor directly in a mouse brain—no nose involved

8. How Dozens of Languages Help Build Gender Stereotypes

Usage patterns shape biases worldwide, whether in Japanese, Persian or English

10. Elon Musk's Pig-Brain Implant Is Still a Long Way from "Solving Paralysis"

His start-up Neuralink is not the first to develop a wireless brain implant. But the considerable resources behind the effort could help commercialize the technology faster

12. COVID-19-Era Isolation Is Making Dangerous Eating Disorders Worse

People with anorexia, bulimia or binge-eating disorder report suffering relapses related to the stress of staying at home

FEATURES

15. In Defense of the Psychologically Rich Life

It involves complex mental engagement, a wide range of deep, intense emotions, and diverse, novel and interesting experiences

18. Emotional Labor Is a Store Clerk Confronting a Maskless Customer

The preeminent sociologist Arlie Russell Hochschild discusses the control over one's feelings needed to go to work every day during a pandemic

OPINION

22. The Problem with Implicit Bias Training

It's well motivated, but there's little evidence that it leads to meaningful changes in behavior

24. Were French People Born to Speak French?

No. The belief that people are suited to speak particular languages by biology is widespread—but wrong

28. The Weirdness of Watching Yourself on Zoom

As babies, we learn that it's ourself we see in a mirror. But online meeting rooms are a whole different thing

30. Penis Size Has Nothing to Do with Masculinity

Mocking men who tote big guns or drive fast cars as "compensating" for their presumably inadequate endowment is sexist and toxic

ILLUSIONS

32. Perplexing Perspectives

Conflicting viewpoints coexist at the crossroads of math and art

Mountain Peaks Seem to Shape Personality Traits in the American West

Topography may contribute to the formation of regional temperament

The designation “mountain man” conjures an image of a rough, bearded, possibly grimy white man living ruggedly and adventurously amid trees, snow, deer and the occasional bear. Although most people who live in the U.S.’s mountain states today do not reflect this narrow, stereotypical extreme, the peaks that surround them may shape personality traits that resonate with the persona.

Findings published in *Nature Human Behaviour* on September 7 suggest that mountainous landscapes may promote openness to new experiences among the people

who live in them. But the authors also reported that denizens of the slopes scored lower for other traits, such as agreeableness and extraversion—in keeping with the stereotype of the laconic individualist that has often been portrayed in Westerns. The spir-

it of adventure seems to come with an embrace of solitude and isolation, all traits that may help adaptation to these harsh environments.

Although the results seem to confirm that mountains can shape some aspects of a “mountain

adventurer,” the impact—what researchers call the effect size—for any one individual might be small, says the study’s first author Friedrich Götz, a Ph.D. candidate and psychologist at the University of Cambridge. Not every single person living along



the Colorado Front Range is a wild-haired, adventurous loner. But mountains may draw out these traits to different degrees in people who live there, creating a sort of broad regional tendency. Even if the effects are relatively small, Götz says, this geographical influence could “scale up to produce consequential outcomes on the regional level.”

The exploration of the “frontier” mystique in the western U.S. needs to be revisited in other mountainous settings before making broader statements about whether “physical topography is associated with personality,” says Michele Gelfand, a distinguished university professor in the department of psychology at the University of Maryland, who was not involved in the study.

Gelfand also raises the question of whether the findings apply primarily to the U.S. and its “loose and individualistic culture.” For example, the study results suggested that mountains might underlie lower scores for conscientiousness, a measure of conformity. If researchers were to look at Switzerland, which is more close-knit and collectivist in its culture, they might find that “conscientiousness is higher in

mountainous regions” there, she says.

To examine the relation between mountain living in the western U.S. and personality, Götz and his colleagues used self-reported data for about 3.39 million people aged 10 to 99 distributed across 37,227 zip codes in the 48 contiguous states, Alaska and Washington, D.C. Almost three quarters of the respondents were white.

The investigators evaluated the “mountainousness” of the zip codes using both elevation and change in elevation. And they looked at the commonly used “big five” markers of personality traits: agreeableness (trust and altruism), conscientiousness (responsibility and adherence to social rules), extraversion (sociability), neuroticism (anxiety or emotional instability) and openness to experience (curiosity and creativity). Then they compared how topography and these personality traits tracked with each other.

The team found that mountains tend to draw out openness to new experiences, emphasizing people’s tendencies toward originality and adventurousness. But they seem to decrease the other four traits.

Even though the “opening of the

“Conscientiousness is higher in mountainous regions.”

—*Michele Gelfand*

West” is long past—at least in terms of European settlement of lands taken from Native Americans in the region—its rugged mountains have “acquired a unique sociocultural meaning” that has lingered even as they have ceased to be the “frontier,” Götz says. That persistent mystique and cultural legacy may still influence people even in the 21st century.

Götz is careful to emphasize that mountains’ effect on personality is only one of many factors that shape broadly regional traits. Just as many gene variants can contribute to who we are, several influences, including “mountainousness,” act in concert to shape personality.

People living in cities might also embrace openness as a personality trait but with more of a social emphasis, Gelfand observes. “In cities, this trait may be adaptive because you are constantly meeting

new people, and there are many weak ties and social networks,” she says. So “while mountainous regions may be also high on openness, that could be for different reasons.”

Although the big-five personality construct is useful, it is “not without flaws” and may not “yield perfectly comparable results across cultures,” Götz says. Given the study’s focus on the sociocultural constructs around settlers moving west across the American landscape, the “cross-cultural generalizability remains an open question,” he says. It’s a question he and his colleagues intend to pursue, examining cultures with populated mountain areas but without the colonialist American frontier legacy.

Because the effects of mountainousness are consistent but small, many other factors need to be assessed as candidates for shaping personality. The big data sets and machine-learning approaches Götz and his colleagues used are excellent tools to search for these small but important factors. Götz says that sorting through the massive amounts of information “will be a long and tedious journey,” not unlike an adventurous trek westward.

—*Emily Willingham*

Cracking the Neural Code with Phantom Smells

Scientists used light to evoke an odor directly in a mouse brain—no nose involved

In the opening of *The Matrix*, columns of strange keyboard characters stream down an old monochrome computer screen. They represent the peeled-back digital curtain of experience, reminding us that every taste, smell and color that we experience is, in a way, a deception—a story computed bit by literal bit in a brain working in the quiet darkness of the skull. We don't need special hardware to enter the Matrix. We just need to understand the special hardware we've been given: our brain.

The reason we can't bend experience to our liking, Matrix-style, is that we don't really understand the neural code. There's no Alan Turing for the brain who can study an arbitrary pattern of brain activity and say, "Right now an image of a beige cat is being experienced." Neuroscientists know that the specific contents of a



sensory experience have to do with the timing and/or spatial patterning of brain activity. But when put to the test, with even the most basic mechanistic questions, our ignorance quickly shows itself. If a couple of brain cells had fired a half-second earlier, would you still see the beige cat? What if three additional cells had fired in quick succession? In response, all neuroscientists could do was shrug and make some generic

claims about codes, patterns and the likely importance of timing. But Dmitry Rinberg of New York University and his research group may have just uncovered a partial answer.

In a fascinating recent paper, the researchers used precisely controlled pinpoints of light to directly insert a phantom smell into a mouse's olfactory brain centers, bypassing the nose altogether. They were also able to systematically adjust that pattern

and test how the animal's experience changed. The study is one of the most audacious and systematic efforts at "experience hacking" yet.

Implanting a specific, reproducible, easily adjustable and completely synthetic percept is no small feat. To do so, Rinberg and his colleagues used genetically modified mice with a light-sensitive channelrhodopsin protein smuggled into their olfactory neurons. When light shines on one of these modified neurons, it evokes neural activity—the brief electrical "spikes" that are the basic language of the nervous system—with timing that can be exquisitely controlled. Because the part of the brain that processes sensory information from the nose is conveniently located near the surface of the skull, the researchers were able to skip the nose and write in an artificial odor of their own design. By stimulating the olfactory brain directly, the team essentially had complete control over which cells were active, what their arrangement was and when they were activated. The scientists had created odors made to order with the flip of a simple light switch.

Most natural smells will evoke widespread and temporally complex

activity in the brain. For the purposes of probing and hacking the neural code, though, the researchers opted for a modest and manageable pattern of six small points, randomly distributed and stimulated in succession—a six-note neuronal melody lasting about a third of a second. The mice will never be able to tell us for sure, but this pattern of “notes” presumably smelled like something to them because it could be distinguished from other odors, as well as other six-note patterns in behavioral tests.

In the key part of the experiment, the mice played a game of “spot the difference.” Because they were first trained to exhibit a licking behavior only in response to the original six-note template, the experimenters could measure how much licking persisted as the pattern was adjusted—and thus how much the mice were fooled by the change. If a specific change—say, leaving out just the first note of the ensemble—was detected easily and reliably, then it was an indicator that that note was consequential to the experience. In contrast, if, for example, changing the identity of the sixth neuronal note wasn’t noticeable, then it had less of an effect on the experience. Consis-

tent with earlier work, much of which was done by Rinberg’s group, the early neuronal notes tended to be more information-rich and important for perception than the later ones. The precise timing of neural activity, more generally, was found to be a key variable for odor coding, which contradicted some influential models that had argued that the brain disregards fine-scaled timing differences. The brain, it seems, cares about the ordering of its notes into melodic patterns—and doesn’t just hear them as stacked chords.

Ideas about neural coding were historically developed from the study of communication systems and computers, meaning they tended to be pretty abstract and framed in terms of idealized “gates,” “nodes” and “channels.” While there’s no shortage of high-level theoretical proposals concerning the storage, representation and routing of information in the brain, they are quite difficult to test in the arena of flesh, blood and behavior. Given this situation, support for theoretical paradigms is often based on evidence that is indirect and correlative, even if it is highly suggestive, and tantalizingly analogous to processes

observed in digital computers. The beauty of the Rinberg team’s paradigm is that it so readily makes the abstract testable (at least, in the context of olfactory coding).

As an example of such a test, take the theoretical proposal of “bar code” representation, in which even the slightest change in a pattern of neural activity—a single cell failing to fire, for example—results in a completely different sensory experience. If this hypothetical highly finicky coding scheme were actually used by the brain, then a single small tweak of the original six-note template pattern should be just as noticeable as a completely new pattern.

In fact, the researchers found nearly the opposite. Just like one flat note in a melody doesn’t render it completely unrecognizable, one slightly nudged note of the original odor “melody” only changed the mouse’s experience slightly. More significant, as more “wrong notes” were deliberately added, they had a simple additive effect on experience (at least as measured by the animal’s ability to distinguish between smells). Perhaps most impressive of all, the team incorporated this observation about the code’s

linearity into a statistical model that accurately predicted the mouse’s behavioral response to any arbitrary scrambling of the six-note pattern.

The paper is an unprecedentedly granular look at what, in the brain, makes a given experience that particular experience. The answer, at least in the context of olfaction, has a humanistic ring to it: an experience is a matter of timing and the sum of many small particulars. It’s still not clear how generalizable these results are outside of olfaction or sensation more broadly. Different brain areas have different computational goals and constraints, so it may be more accurate to speak of the organ’s various codes than some single all-purpose one.

We’re also still mostly in the dark about how to stimulate the brain to cook up a complex perceptual experience that’s chosen in advance. Rinberg and his colleagues’ work very strategically only asked how things smelled relative to a starting template. For now the Matrix is still a long way off. But if we ever achieve full-on Matrix-like simulations in the distant future, this study will have been an important early milestone. —Jason Castro

How Dozens of Languages Help Build Gender Stereotypes

Usage patterns shape biases worldwide, whether in Japanese, Persian or English

Linguists use machine-learning techniques for mining large text corpora to detect how the structure of a language lends meaning to its words. They work on the assumption that terms that appear in close proximity to one another may have similar connotations: dogs turn up near cats more often than canines appear close to bananas.

This same method of burrowing into texts—more formally called the search for distributional semantics—can also provide a framework for analyzing psychological attitudes, including gender stereotypes that contribute to the underrepresentation of women in scientific and technical fields. Studies in English have shown, for example, that the word “woman” often appears close to “home” and “family,” whereas



“man” is frequently paired with “job” and “money.”

The way language fosters linguistic stereotypes intrigued Molly Lewis, a cognitive scientist and special faculty member at Carnegie Mellon University, who focuses on the subtle ways words convey meanings. Along with Gary Lupyan of University of Wisconsin–Madison, she decided to build on

earlier work on gender stereotypes to explore how common these biases are throughout the world. In a study in August in *Nature Human Behaviour*, the researchers find that such stereotypes are deeply embedded in 25 languages. *Scientific American* spoke with Lewis about the study’s findings. [An edited transcript of the interview follows.]

How did you come up with the idea for the study?

There’s a lot of previous work showing that explicit statements about gender shape people’s stereotypes. For example, if you tell children that boys are better at being doctors than girls, they will develop a negative stereotype about female doctors. That’s called an explicit stereotype.

But there is little work exploring a different aspect of language looking at this question of gender stereotypes from the perspective of large-scale statistical relationships between words. This is intended to get at whether there is information in language that shapes stereotypes in a more implicit way. So you might not even be aware that you’re being exposed to information that could shape your gender stereotypes.

Could you describe your main findings?

In one case, as I mentioned, we were focusing on the large-scale statistical relationships between words. So to make that a little more concrete: we had a lot of text, and we trained machine-learning models on that text to look at whether words such as “man” and “career” or “man” and

“professional” were more likely to co-occur with each other, relative to words such as “woman” and “career.” And we found that, indeed, they were [more likely to do so]—to varying degrees in different languages.

So in most languages, there’s a strong relationship between words related to a man and words related to a career—and, at the same time, words related to women and words related to family. We found that this relationship was present in nearly all the languages that we looked at. And so that gives us a measure of the extent to which there is a gender stereotype in the statistics of the 25 different languages we looked at.

And then what we did was ask whether or not the speakers of those languages have the same gender stereotype when measured in a particular psychological task. We had a sample of more than 600,000 people with data collected by other researchers in a [large crowdsourced study](#). The psychological task was called the Implicit Association Test (IAT). And the structure of that task was similar to the way we measured the statistical relationships between words in language. In the task, a

study participant is presented with words such as “man” and “career” and “woman” and “career,” and the individual has to categorize them as being in the same or a different category as quickly as possible.

So that’s how people’s gender stereotypes are quantified. Critically, what we did then was compare these two measures. Speakers [who] have stronger gender stereotypes in their language statistics also have stronger gender stereotypes [themselves], as measured by the IAT. The fact that we found a strong relationship between those two is consistent with the hypothesis that the language that you’re speaking could be shaping your psychological stereotypes.

Wasn’t there also another measure you looked at?

The second finding is that languages vary in the extent to which they use different words to describe people of different genders in professions. So in English, we do this with “waiter” and “waitress” to describe people of different genders. What we found was that languages that make more of those kind of gender distinctions in occupations were more likely to have speakers with

a stronger gender stereotype, as measured by the IAT.

Don’t some languages have these distinctions built into their grammar?

We also looked at whether or not languages that mark gender grammatically—such as French or Spanish—by putting a marker at the end of a word in an obligatory way [*enfermero* (masculine) versus *enfermera* (feminine) for “nurse” in Spanish, for example] have more gender bias. And there we didn’t find an effect.

Was that observation surprising?

It was surprising because some prior work suggests that [the existence of a bias effect] might be the case—and so we sort of expected to find that, and we didn’t. I wouldn’t say our work is conclusive on that point. But it certainly provides one data point that suggests that [aspect of language is] not driving psychological bias.

Some of your findings about gender stereotypes had been studied in English before, hadn’t they?

What I would say is that our contribution here is to explore this ques-

tion cross-linguistically and to directly compare the strength of the psychological gender bias to the strength of the statistical bias in language—the word patterns that reveal gender bias. What we did was show that there’s a systematic relationship between the strength of those two types of biases.

One of the points you make is that more work will be needed to prove a cause-and-effect relationship between languages and gender stereotypes. Can you talk about that?

I think that this is really important. All of our work is correlational, and we really don’t have strong evidence for a causal claim. So I could imagine a couple of ways that we can get stronger causal evidence. One would be to look at this longitudinally to find a way to measure bias and language over time—say, over the past 100 years. Does change in the strength of language bias predict later change in people’s gender stereotypes?

A more direct way to find evidence for the causal idea would be to do experiments in which we would statistically manipulate the kind of word

patterns (linguistic statistics) that a person was being exposed to—and then measure their resulting psychological gender stereotypes. And if there were some sort of evidence for a relationship between the statistics of a language and stereotypes, that would provide stronger evidence for this causal idea.

If it does prove to be true that some of our gender stereotypes are shaped by language, will that effect in any way impede people’s ability to change them?

I think the opposite, actually. I think this work tells us one mechanism whereby stereotypes are formed. And I think this gives us a hint of how we could possibly intervene and, ultimately, change people’s stereotypes. So I have another body of work looking at children’s books and measuring the implicit stereotypes in [those] texts. And there we find that stereotypes are even larger than the ones that we report in our paper. One promising future direction is changing which books are being read to children—or which digital media are being given to children. And that might alter the stereotypes developed. —Gary Stix

Elon Musk’s Pig-Brain Implant Is Still a Long Way from “Solving Paralysis”

His start-up Neuralink is not the first to develop a wireless brain implant. But the considerable resources behind the effort could help commercialize the technology faster



Elon Musk

In August, Elon Musk’s brain tech start-up Neuralink unveiled the latest version of its neural implant technology. In characteristic Musk style, the billionaire CEO of SpaceX and Tesla announced the news during a widely hyped livestreamed event in which he showed off the implant’s functionality in several pigs.

The device is about the size of a large coin and can be fully embedded in the skull. Attached to it are 1,024 threadlike, flexible electrodes

that extend down into the cerebral cortex, the outer layer of the brain responsible for numerous functions, including motor control and sensory feedback. A customized computer chip in the device amplifies signals from the cortex and wirelessly relays them to a nearby computer. The electrodes are carefully inserted by a surgical robot and are capable of recording (and, theoretically, also generating) the tiny electrical signals, or “spikes,” produced by individual neurons. The idea is that these signals could be used to one day do things such as restore movement to people who are paralyzed or create a visual prosthesis for blindness.

During Musk’s demonstration, he strolled near a pen containing several pigs, some of which had Neuralink implants. One animal, named Gertrude, had had hers for two months. The device’s electrodes were situated in a part of Gertrude’s cortex that connected to neurons in her snout. And for the purposes of the demo, her brain signals were converted to audible bleeps that became more frequent as she sniffed around the pen and enjoyed some tasty treats. Musk also showed off a pig whose implant had been successfully removed to

show that the surgery was reversible. Some of the other displayed pigs had multiple implants.

Neuralink, which was founded by Musk and a team of engineers and scientists in 2016, unveiled an earlier, wired version of its implant technology in 2019. It had several modules: the electrodes were connected to a USB port in the skull, which was intended to be wired to an external battery and a radio transmitter that were located behind the ear. The latest version consists of a single integrated implant that fits in a hole in the skull and relays data through the skin via a Bluetooth radio. The wireless design makes it seem much more practical for human use but limits the bandwidth of data that can be sent, compared with state-of-the-art brain-computer interfaces.

The company's goal, Musk said in the demo, is to "solve important spine and brain problems with a seamlessly implanted device"—a far cry from his previously stated, much more fantastic aim of allowing humans to merge with artificial intelligence. This time Musk seemed more circumspect about the device's applications. As before, he insisted the demonstration was purely intended as a recruiting

event to attract potential staff.

Neuralink's efforts build on decades of work from researchers in the field of brain-computer interfaces. Though technically impressive, this wireless brain implant is not the first to be tested in pigs or other large mammals. About a decade ago Brown University scientists David Borton and Arto Nurmikko and their colleagues developed a wireless neurosensor that was capable of recording neural activity from pigs and monkeys. In 2016 the researchers showed it could be used to help paralyzed monkeys walk.* "Neuralink, with a lot of creativity, has been able to cut and paste a lot of stuff that the field has developed," Nurmikko says. The technology may not be unique, he adds. But "might it have a robust future in terms of actually getting into humans? That's kind of the pending question, and the answer could very well be yes."

Musk and Neuralink are devoting significant resources to their project. "It is an extremely well-funded, focused effort. They said they have 100 people working on this," says Ken Shepard, a professor of electrical and biomedical engineering at Columbia University. "That's a level



Neuralink implantable device

of resources that is pretty impressive to work on something like this. I think that gives them a real advantage over other groups."

Neuralink's robotic technology for inserting flexible electrodes is very notable, Shepard says. There will be challenges in scaling up the number of polymer electrodes, or "threads," and the interconnections between them and the integrated circuit chip, he says. The data bandwidth will also have to increase:

recording from 1,000 electrodes yields a large amount of information, so Neuralink must compress it to relay it over Bluetooth.

"Where we're at is: we have [basically] a prototype of the iPhone or a 'Fitbit for the brain,' and there are a whole bunch of refinements that need to be done" in terms of the surgery, the device itself, the wireless range, data transfer, and so on, says Shivon Zilis, a project director at Neuralink. "There are so many

optimizations that have to happen in between prototype and the thing that you are super-duper proud of that you want to [show] consumers as your first product.”

The U.S. Food and Drug Administration recently granted Neuralink a “breakthrough device” designation, which essentially means the company has submitted the paperwork to start the process of gathering the data necessary for FDA approval. There are numerous challenges to overcome before the device could be ready for human use, however. It will have to be shown to be safe and not cause any damage to brain tissue. And its sensitive electronics must be able to withstand the corrosive environment of the human body.

Neuralink is not the only company venturing into the realm of brain-computer interfaces. An Austin-based company called Paradromics—funded by the U.S. government’s Defense Advanced Research Projects Agency—is also developing one potentially capable of recording signals from tens of thousands of neurons. The project aims to restore communication to people with paralysis who have lost the ability to speak or type. And the Culver City,

Calif.–based company Kernel is developing a helmetlike device for monitoring brain signals noninvasively, which can be used to do things such as identify what song a person is listening to. It lacks the resolution of Neuralink’s device and similar implanted systems but has the benefit of not requiring brain surgery.

Still, devices such as Neuralink’s will likely be made less invasive over time as electrodes become thinner and more flexible and as robotic insertion becomes more streamlined. Musk has previously compared the process to LASIK eye surgery, which is now routine. But as with any surgery, the reward will have to be weighed against the risk. Shepard thinks noninvasive approaches have real advantages for applications involving healthy people. “It’s hard for me to imagine, in my lifetime, a day in which a healthy person would have surgery to have [an implant] put in their brain,” he says. —*Tanya Lewis*

*Editor’s Note: *The author worked as an undergraduate in a lab led by Leigh Hochberg of Brown University, who is an adviser to Neuralink. Arto Nurmikko also collaborates with Hochberg’s lab but is not affiliated with Neuralink.*

COVID-19-Era Isolation Is Making Dangerous Eating Disorders Worse

People with anorexia, bulimia or binge-eating disorder report suffering relapses related to the stress of staying at home

Rosey has lived with bulimia for more than a decade. The 31-year-old resident of Melbourne, Australia, started therapy for her eating disorder six years ago. Although she says she had never considered herself “cured,” she had reached a point in her recovery that felt hopeful and manageable. Then along came the novel coronavirus.

When mandatory COVID-19 lockdowns began in Australia in March, Rosey’s anxiety went into overdrive. “I’m single, I live alone, my family lives in another state, and I’m not able to see friends,” she says, adding that her need for control—something she has now lost in almost every area of her life—has played a major role in the resurgence of symptoms: “To have everything I knew and had

control over, including how I managed my illness, ripped away has been one of the hardest things.”

Rosey is living an experience that may be familiar to anyone dealing with an eating disorder while weathering the unexpected storms of 2020. Recent research indicates that pandemic-related stay-at-home orders have ramped up anorexia, bulimia and binge-eating disorder symptoms.

ISOLATION HITS HOME

A study published in July in the *International Journal of Eating Disorders* revealed that during the first few months of the pandemic, many individuals with anorexia reported restricting their eating more. Meanwhile others with bulimia and binge-eating disorder reported more bingeing urges and episodes. Respondents also noted increased anxiety and concern about COVID-19’s impact on their mental health. More than one third of the 1,021 participants (511 in the U.S. and 510 in the Netherlands) said their eating disorder had worsened—and they attributed this change to issues such as a lack of structure, a triggering environment, the absence of social support and an inability to

obtain foods that fit their meal plans.

“While no one knows for sure what causes eating disorders, a growing consensus suggests that [they result from] a range of biological, psychological and sociocultural factors,” says Claire Mysko, CEO of the National Eating Disorders Association, who was not involved in the study. She notes that many of those who struggle with these disorders have a co-occurring condition, such as anxiety or depression.

The paper’s senior author Cynthia M. Bulik of the University of North Carolina at Chapel Hill notes that anxiety and depression are on the rise for many because of the pandemic—and this increase can present specific triggers to those with eating disorders. Such triggers “are almost custom-made to exacerbate their illness,” says Bulik, who is the founding director of the U.N.C. Center of Excellence for Eating Disorders.

One major provocation is social isolation. “Eating disorders are something individuals usually keep private, and there can be a lot of shame around behaviors,” says Ellen E. Fitzsimmons-Craft, an assistant professor of psychiatry at the Washington University School of Medicine, who specializes in eating disorder pre-



vention and treatment research. These disorders “also thrive in isolation, so it’s not surprising we’re seeing an increase in disordered behaviors and even some relapse among those who were doing well prior to lockdown,” says Fitzsimmons-Craft, who was not involved in the new study.

To fill the void left by physical distancing, many people are logging hours online—a phenomenon that may actually be complicating matters for some with eating disorders. “Social media messages about being productive, effectively using time in quarantine and avoiding the ‘COVID-19 weight gain’ have led to increased negative self-talk,” says

Shiri Sadeh-Sharvit, associate director of training at the Center for m²Health at Palo Alto University.

Sadeh-Sharvit and her colleagues published a paper in July that examined risks and recommendations for people suffering from eating disorders in this unprecedented situation. Lead study author Marita Cooper, a postdoctoral fellow at the Johns Hopkins University School of Medicine, says food-specific issues related to the pandemic also play a role. “Reduced food access, or food insecurity, [has] been rampant,” she says. “The need to stock a ‘quarantine pantry’ can be a significant challenge, potentially triggering bingeing

and compensatory episodes,” such as self-induced vomiting, laxative misuse, fasting or excessive exercise.

Sarah Adler, a psychologist at Stanford University’s Eating Disorder and Weight Control Clinic, says food scarcity can create anxiety in anyone. But, she adds, “the specific stress and anxiety associated with decisions about food and availability of food can dramatically increase anxiety in folks with eating disorders.”

Food is one part of the eating disorder equation; exercise is often another. “For those whose disorder includes compulsive exercise, either they’re very anxious because they can’t go to the gym or find themselves exercising excessively at home because there are no barriers to doing so,” Bulik says, adding that some people might even experience both of these effects.

Rosey knows about this problem firsthand. She says she has ramped up her home exercise routine since the pandemic began. “I knew I wouldn’t be able to stick to my very strict and regimented workout schedule with gyms closed, which sent my body dysmorphia into a downward spiral,” she says. “I walk or jog every day to know how many calories I’ve burned.”

TREATMENT CHALLENGES

The pandemic has also highlighted the limitations of electronic means of accessing treatment. In Bulik’s research, 47 percent of U.S. respondents say telehealth (seeking care over the phone or online) is not cutting it, compared with in-person treatment. And 45 percent of those surveyed in the U.S. say they are not receiving treatment at all.

“Face-to-face therapy has largely been discontinued, so a primary source of support and accountability has been moved online,” Bulik says. “Some things are just hard to do online, like weighing to make sure someone is not losing too much weight or [to see] whether they’re gaining according to plan. The logistics are much more complex with virtual care.”

Rosey says continuing therapy by phone has been helpful—to an extent. “Talking to someone who knows my history has lifted a bit of the weight off my shoulders,” she says. “But I think taking away that face-to-face interaction removes a lot of the accountability.”

One possible upside is that providers can now glean more insights about what works online and what

does not. “Clinicians cannot assume that virtual therapy is the same as in-the-room therapy,” Bulik says. “You have to do a lot of experimenting to make sure patients have safe and private spaces and work together to figure out ways to make it function as close to a face-to-face session as possible.”

She also recommends augmenting sessions with digital resources such as Recovery Record, an eating disorder recovery app that uses cognitive-behavioral therapy techniques to allow users to track progress and share data with their treatment team. Fitzsimmons-Craft is conducting a study investigating the benefits of another mobile mental health app. “Digital mental health can bring treatment to people exactly when and where they need it,” she says.

“I believe the delivery of treatment will change in the wake of COVID-19,” says Ruth Striegel Weissman, a professor of psychology at Wesleyan University. “We’ll see far more telehealth, and I think therapists will get better at it. What’s unusual about the current situation is that the change was rapid, and therapists themselves are in a state of transition and stress.” She says the sudden shift

“A crisis such as COVID-19 may help ‘reset’ behavioral patterns and, for some people, represent an opportunity for positive change or personal growth.”

—Ruth Striegel Weissman

has left many experts scrambling. And some of her colleagues have been forced to take client calls from their closet because of a lack of privacy at home.

Another potential bright side: although the majority of respondents to Bulik’s survey reported lockdown-related adversity, others said they noticed positive effects, including greater family connection, more self-care time and increased motivation for recovery. “I was fascinated that some [people] actually reported improvements,” Weissman says. “A crisis such as COVID-19 may help

‘reset’ behavioral patterns and, for some people, represent an opportunity for positive change or personal growth.”

According to Cooper, the treatment industry needs to adapt and catch up. “Eating disorders are manageable and treatable—most people who receive evidence-based treatment will recover,” she says. “We just need to improve accessibility and reduce stigma about accessing treatment.”

For Rosey, the struggle continues. “Every day I tell myself it will be better,” she says. “I try to put some of the management methods I’ve used over the years into practice. Some days it works. But others, I feel powerless.”

—Michelle Konstantinovsky

If you or someone you know is struggling with an eating disorder, you can contact the National Eating Disorders Association’s Helpline by calling (800) 931-2237 or [clicking here to chat](#). For crisis situations, you can text “NEDA” to 741741 to connect to a trained volunteer at the Crisis Text Line.

In Defense of the Psychologically Rich Life

It involves complex mental engagement,
a wide range of deep, intense emotions, and
diverse, novel and interesting experiences

By Scott Barry Kaufman



“I do not accept any absolute formulas for living. No preconceived code can see ahead to everything that can happen in a man’s life. As we live, we grow, and our beliefs change. They must change. So I think we should live with this constant discovery. We should be open to this adventure in heightened awareness of living. We should stake our whole existence on our willingness to explore and experience.”—MARTIN BUBER

What does it mean to live a good life? This question has been debated and written about by many philosophers, thinkers and novelists throughout the course of humanity. In the field of psychology, two main conceptualizations of the good life have predominated: A happy life (often referred to as “hedonic well-being”), full of stability, pleasure, enjoyment and positive emotions, and a meaningful life (often referred to as “eudaimonic well-being”), full of purpose, meaning, virtue, devotion, service and sacrifice. But what if these aren’t the only options?

In recent years, a long-neglected version of the good life has been receiving greater research attention: the psychologically rich life. The psychologically rich life is full of complex mental engagement, a wide range of intense and deep emotions, and diverse, novel, surprising and interesting experiences. Sometimes the experiences are pleasant, sometimes they are meaningful, and sometimes they are neither pleasant nor meaningful. They are, however, rarely boring or monotonous.

After all, both happy and meaningful lives can become monotonous and repetitive. A person with a steady office job, married with children, may be generally satisfied with their life and find many aspects of their life meaningful and still be bored out of their mind. Also, the psychologically rich life doesn’t necessarily involve economic richness. For instance, consider Hesse’s character Goldmund, who has no money but pursues the life of a wanderer and a free spirit.

Recent research on psychological richness has found that it is related to, but partially distinct from, both happy and meaningful lives. Psychological richness is much more strongly correlated with curiosity, openness to experience, and experiencing both positive and negative emotions more intensely. But is the psychologically rich life one that people actually want?

In a new study, Shigehiro Oishi and his colleagues propose that psychological richness is a neglected aspect of what people consider a good life and set out to assess

Scott Barry Kaufman is a humanistic psychologist exploring the depths of human potential. He has taught courses on intelligence, creativity, and well-being at Columbia University, NYU, the University of Pennsylvania, and elsewhere. He hosts The Psychology Podcast, and is author and/or editor of nine books, including *Transcend: The New Science of Self-Actualization*, *Wired to Create: Unravelling the Mysteries of the Creative Mind* (with Carolyn Gregoire), and *Ungifted: Intelligence Redefined*.

how much people around the world actually desire such a life. The researchers asked people living in nine diverse countries the degree to which they value a psychologically rich life, a happy life and a meaningful life.

They found that many people’s self-described ideal lives involve psychological richness. When forced to choose a life, however, the majority chose a happy life (ranging from 49.7 percent to 69.9 percent) and a meaningful life (14.2 percent to 38.5 percent). Even so, a substantial minority of people still favored the psychologically rich life, ranging from 6.7 percent in Singapore to 16.8 percent in Germany.

These numbers went up when the desire for a psychologically rich life was measured indirectly. To fully understand what a person wishes their life might have been, it is important to explore what that person wishes they had avoided in their life. Therefore, Oishi and his colleagues asked people what they regret most in their lives and whether undoing or reversing this regrettable life event would have made their lives happier, more meaningful or psychologically richer.

They found that about 28 percent of Americans said that undoing the regrettable event would have made their lives psychologically richer. For instance, one person wrote that they regretted “not going to a four-year college to get a degree. I feel like I missed out on some interesting experiences.” In Korea, the percentage was even higher, with 35 percent of participants saying that undoing the regrettable event would have made their

lives psychologically richer [compared with happier (27.6 percent) or more meaningful (37.4 percent)].

These findings suggest that while most people do strive to be happy and have meaning and purpose in their lives, a sizable number of people are content merely living a psychologically rich existence. Indeed, other emerging research suggests that for a lot of people, the intensity of the experience matters more than merely how “positive” or “negative” it was. As Oishi and his colleagues conclude, “we believe that taking the psychologically rich life seriously will deepen, broaden and, yes, enrich our understanding of well-being.”

At the end of the day, there is no one singularly acceptable path to the good life. You have to find a path that works best for you.

As Nietzsche put it: “No one can build you the bridge on which you, and only you, must cross the river of life. There may be countless trails and bridges and demigods who would gladly carry you across, but only at the price of pawning and forgoing yourself. There is one path in the world that none can walk but you. Where does it lead? Don’t ask, walk!”

The philosopher also noted, however, that it is “an agonizing, hazardous undertaking thus to dig into oneself, to climb down roughly and directly into the tunnels of one’s being.”

If you dig deep into the tunnels of your being and realize that the best path for you is to live a life full of rich and complex ideas, emotions and experiences (which sometimes can be negative but ultimately conducive to growth), then I hope this research shows you that this is not necessarily a lonely path. There are plenty of people in the world who crave the psychologically rich life and who even prioritize novelty, variety, complexity, intensity, depth and surprise in their daily lives. **M**

Scientific American Unlimited

Perfect for science fans, gain access to all of our publications, apps & the full website experience.



Digital archive access back to 1845 including articles by Einstein, Curie and other timeless luminaries in more than 7,000 issues!

12 print and digital issues of *Scientific American* per year

More than 150 eBooks and Collector's Editions

Access to *Scientific American Mind*, *Space & Physics* and *Health & Medicine*

More than 200 articles per month, including news and commentary, on ScientificAmerican.com

Subscribe

Emotional Labor Is a Store Clerk Confronting a Maskless Customer

The preeminent sociologist Arlie Russell Hochschild discusses the control over one's feelings needed to go to work every day during a pandemic

By Gary Stix



Gary Stix is a senior editor at *Scientific American*.
He writes the blog Talking Back at ScientificAmerican.com.

TWO MEN WALKED INTO A TRADER JOE'S SUPERMARKET in Manhattan near closing time one day in July. When an employee asked them to put on masks, they allegedly proceeded to rip a mask from one worker's face, hit another and pull the hair of a third. Such physical attacks are less common than a string of expletives when a customer is asked to wear a face covering as a safeguard against COVID-19 transmission. But amid the stress of a dangerous global pandemic, combined with the extreme political polarization of protective measures in the U.S., there have still been an alarming number of outright assaults.

The Centers for Disease Control and Prevention recently issued guidance saying employees at retail establishments and other service business should refrain from arguing with a customer when confronted with an attack or threat of violence over a request to put on a mask. If at all possible, they should retreat to a safe, lockable room.

Since March, anyone who works in a supermarket or other retail business now has a complex job description that goes beyond stocking shelves or running a cash register. It has become necessary to appease the antimask contingent but also to maximize a customer's chances of traversing a store's narrow aisles without testing positive for COVID-19 a few days later.

The emotional balancing act required to juggle fear for one's personal safety with a professional steadiness in the face of a circulating pathogen that can sicken and

kill continues to challenge the people who show up on the job each day—whether they be critical care physicians or supermarket cashiers.

Almost 40 years ago sociologist Arlie Russell Hochschild, now a professor emerita at the University of California, Berkeley, began an examination of the task of keeping emotions in check in service-sector jobs. She observed flight attendants—who were taught to keep smiling, no matter how difficult a passenger might get—and authored *The Managed Heart: Commercialization of Human Feeling*. To describe such required exertions, Hochschild came up with the term “emotional labor”—a concept that now has relevance to the harsh stresses confronted by essential workers. *Scientific American* recently asked her about emotional labor in the time of COVID-19.

[An edited transcript of the interview follows.]

A Google search of “emotional labor” brings up hundreds of thousands of references. But it still seems useful to define the term and perhaps to discuss how it has evolved over the years. Can you give a brief explanation?

As I defined it in my 1983 book *The Managed Heart*, emotional labor is the work we do to evoke or suppress feeling or emotion in the service of doing paid work—that is, by managing emotion. Usually it goes along with mental work and physical work, but it is, in itself, a singular form of labor. It calls for a distinct kind of skill, offers its own kind of reward and exacts its own kind of costs. The economy was once mainly based on premechanized jobs, such as those of lumberjacks, coal miners, farmers—jobs calling for physical labor. Such workers managed their emotions, too, of course—a farmer cursing a rainless sky, a miner fearing a collapse in his mine—but such feelings are incidental to, and not an intrinsic part of, their work, as it is for service-sector workers required to conduct face-to-face or voice-to-voice contact with the public.

In *The Managed Heart*, I describe the work of flight attendants—whose job (in some airlines) is to try to be “nicer than natural”—and bill collectors—whose job (in some agencies) is to be nastier than natural. Most of us—teachers, nurses, social workers, sales clerks, tattoo parlor artists, prison guards, nannies, elder care workers, wedding planners, funeral parlor attendants—do emotional labor that falls somewhere between these two extremes.

Sometimes the job calls for displaying the right emo-

tion, as when a funeral parlor attendant feigns sorrow and performs what I call “surface acting.” Other times it calls for trying to really feel the feeling appropriate to the moment and the job—what I call “deep acting.”

Off the job, as friends, parents, siblings, co-parishioners, we are called on to manage our feelings, too, of course. We comfort a frightened child, calm a rageful neighbor, grieve a lost parent. Here we are called to manage our emotions, but we’re not paid for it. So I give this a different name: “emotion work,” as opposed to “emotional labor.”

The pandemic has brought about an outpouring of gratitude toward frontline workers, whether at the hospital or supermarket. But it has also created an intense amount of stress: The nurse who has to hold it together when telling people they can’t see a dying family member. The store employee who receives abuse from customers after they encounter a bare shelf when looking for disinfecting wipes. Do you think that your ideas about emotional labor can help explain what these essential workers are feeling?

Oh, yes. The demands on first responders are often intense. When I say “first responder,” I refer to many workers: doctors and nurses—especially those working in the ICU [intensive care unit]—nurses’ aides, EMTs, paramedics and physical therapists, as well as child care workers, nursing home caregivers, security personnel, food service deliverers and servers, janitors, mail carriers, bus, taxi, Uber and Lyft drivers, teachers, hotel and restaurant workers, and others in “essential jobs” maintaining daily contact with the public—some of whom are, or may be, sick.

They do emotional labor of two broad types. One, I would call “bracketing.” This refers to the effort to get our own, often extreme, anxieties “behind” us. Emotion-

ally speaking, this calls for the work of temporarily detaching ourselves from a set of feelings that emerge—sadness, anxiety, panic—in response to events, real or imagined, in our own life. An ICU nurse who is intubating an ill patient may be strongly reminded of her own mother who’s developed a bad cough. Or she may worry she is exposing her small children to COVID-19 or [she may have] left a pet dog at home for the length of a 10-hour shift. These worries don’t arise from the job itself. They are on her mind and require the emotional labor of “setting aside,” or bracketing, situations away from work. Bracketing is the work of maintaining focus on an immediate task, of telling oneself again and again, “I can’t worry about my own situation now.”

You mentioned another type. Can you describe it?

A second type of emotional labor of COVID-19 first responders is “bridging.” It includes a broad category of emotional tasks. In bridging, we’re focusing on the urgent needs of those stricken by COVID-19 and must try to empathize with the victims of it—bridging the differences between self and victim. As one exemplary EMT said, “I try to think of every patient as like a member of my family.”

And circumstances can be dire because COVID-19 adds new danger to preexisting ones. The very poor and homeless, for example—already desperate for warmth and food, comfort—now fear the spread of illness or may be in denial of it. Prisoners, already lonely, some mentally ill, now face fear of contagion. Public hospitals, already facing scarcities, are now overwhelmed with more sick patients than there are beds. Working with populations in these hotspots forces the emotional laborer to confront chaos [and] pandemonium and deal with their own sense of horror, similar to that faced by soldiers in wartime. Many first responders trained as civilians are now faced with the equivalent of war. The internal task

for the emotional laborer is to absorb—meaning to manage feelings about—immediate horrors while not feeling overwhelmed by them.

In bridging to the needs of others, workers may have to deal with their own sense of failure. The EMT mentioned above reported sadly about a patient, “He died on my stretcher.” Workers also have to deal with the anger of family members. Helpless to rescue a loved one, a family member may lash out in anger and displace blame onto the caregiver: “You failed” or “This hospital failed.” A defiant shopper may express outrage at being required to wear a mask, requiring the store worker to mollify, absorb, listen nonreactively to angry talk and threatening gestures. Or a worker may genuinely feel remorse at a failure to rescue a needy patient.

Does having to maintain one’s composure while risking one’s own health raise the possibility of long-lasting psychological consequences?

Yes, frontline workers can become shell-shocked or develop PTSD [post-traumatic stress disorder] or simply burn out.

Does emotional labor also have relevance to the country’s race-related tensions? The Strike for Black Lives on June 10 was partially thought of as a respite from the emotional labor of being Black in academia—having to appear at diversity workshops, mentor Black students, and the like.

Yes, here a person is often addressed in ways that don’t correspond with their self-definition. A Black person may be treated as a “representative” of “all Black people”—“Tell me how you people feel”—in ways that jar or alienate. Or in other ways, people of color—and, really, minorities of every sort—face the task of peeling off other people’s projections onto them: “You must be affirmative-action hires.” Any member of a minority, whether

based on gender, sexuality, religion, disability or personality, is tacitly given the extra emotional task of helping others relate to oneself in a relaxed and accepting way.

You have also written about the inequities in housework in your book *The Second Shift*. Do you think extended quarantines and lockdowns have exacerbated stresses related to domestic responsibilities—that is, when couples must work at home while tending to children and having to deal with all the tasks of running a household as well?

On the other side of the “brackets” mentioned earlier is the world of children, parents, lovers, friends. The “second shift” is an additional source of demands because it requires our effort to stay closely attuned to loved ones, address their primal needs while hoping and trying for a parallel attunement to one’s own—also sometimes overwhelming—needs. Loved ones may feel abandoned by the preoccupied frontline worker and so feel angry and hurt. One may feel guilty for subtracting attention from needy children or a spouse. And the frontline worker may have to ask preoccupied family members for help in recovering from an overwhelming day.

Is there any other important issue that I’m leaving out linked to emotional labor and the pandemic?

Yes, underlying any task of emotional labor is a prior notion of the “right way” or “wrong way” to feel at a particular moment—in a particular situation at a particular historical period in a particular culture. It is through “feeling rules,” as I call them, that we incorporate culture into our daily lives.

Also, balancing: whether bracketing or bridging, at the heart of emotional labor is the art of balancing the need to “manage” emotion with the need to let go and simply feel emotion. And here, too, we encounter feeling

rules in the form of a cultural ideal of balance. But whatever ideal we’re aiming for, in balancing, we need to control our emotions enough but also not too much. That is, partly, we have to discipline our feelings—to play them like a piano: If addressed in anger, not to strike back. Or if addressed in grief and depression, not to descend into it oneself. On the other hand, we need to feel our emotions. Emotion is like sight or hearing: it is a sense through which we know the world and our relationship to it. To go numb is to be struck blind. Hence the importance of knowing about what so many of us practice without giving it the name: emotional labor. **M**

Editor’s Note: *Besides *The Managed Heart*, there are two other books by Arlie Russell Hochschild that discuss emotional labor: *The Outsourced Self: Intimate Life in Market Times* (Metropolitan Books, 2012) describes the experiences of nannies, elder care workers, surrogate mothers, life coaches, wedding and birthday planners, and funeral organizers, such as “the Shiva Sisters.” And *So How’s the Family and Other Essays* (University of California Press, 2013) contains several essays on the topic—including “Can Emotional Labor Be Fun?” “Rent-a-Mom,” “Time Strategies” and “The Surrogate’s Womb.”*

Digital Matter about Your Gray Matter

SCIENTIFIC
AMERICAN® eBooks

In-depth Coverage on Neurology,
Consciousness, Behavior and More

Buy Now



Tiffany L. Green, Ph.D., is an assistant professor in the department of population health sciences and the department of obstetrics and gynecology at the University of Wisconsin–Madison.

Nao Hagiwara, Ph.D., is an associate professor in the department of psychology at Virginia Commonwealth University.

BEHAVIOR & SOCIETY

The Problem with Implicit Bias Training

It's well motivated, but there's little evidence that it leads to meaningful changes in behavior

While the nation roils with ongoing protests against police violence and persistent societal racism, many organizations have released statements promising to do better. These promises often include improvements to hiring practices; a priority on retaining and promoting people of color; and pledges to better serve those people as customers and clients.

As these organizations work to make good on their declarations, implicit bias training is often at the top of the list. As the thinking goes, these nonconscious prejudices and stereotypes are spontaneously and automatically activated and may inadvertently affect how white Americans see and treat Black people and other people of color. The hope is that, with proper training, people can learn to recognize and correct this damaging form of bias.



In the health care industry, implicit bias is among the likely culprits in many persistent racial and ethnic disparities, like infant and maternal mortality, chronic diseases such as diabetes and, more recently, COVID-19. Black Americans are about 2.5 times more likely to die from COVID-19 relative

to whites, and emerging data indicate that Native Americans are also disproportionately suffering from the pandemic. Implicit biases may impact the ways in which clinicians and other health care professionals diagnose and treat people of color, leading to worse outcomes. In response to these

disparities, Michigan and California have mandated implicit bias training for some health professionals.

There's just one problem. We just don't have the evidence yet that implicit bias training actually works.

To be sure, finding ways to counter unfair treatment is critical. The evidence is clear that implicit prejudice, an affective component of implicit bias (that is, feeling or emotion), exists among health care providers with respect to Black and Latinx patients, as well as to dark-skinned patients not in those categories. In turn, these biases lower the quality of patient-provider communication and result in lower satisfaction with the health care encounter.

But while implicit bias trainings are multiplying, few rigorous evaluations of these programs exist. There are exceptions; some implicit bias interventions have been conducted empirically among health care professionals and college students. These interventions have been proven to lower scores on the Implicit Association Test (IAT), the most commonly used implicit measure of prejudice and stereotyping. But to date, none of these interventions has been shown to result in permanent, long-term reductions of implicit bias scores or, more important, sustained and meaningful changes in behavior (that is, narrowing of racial/ethnic clinical treatment disparities).

Even worse, there is consistent evidence that bias training done the “wrong way” (think lukewarm diversity training) can actually have the opposite impact, inducing anger and frustration among white employees. What this all means is

that, despite the widespread calls for implicit bias training, it will likely be ineffective at best; at worst, it's a poor use of limited resources that could cause more damage and exacerbate the very issues it is trying to solve.

So what should we do? The first thing is to realize that racism is not just an individual problem requiring an individual intervention but a structural and organizational problem that will require a lot of work to change. It's much easier for organizations to offer an implicit bias training than to take a long, hard look and overhaul the way they operate. The reality is, even if we could reliably reduce individual-level bias, various forms of institutional racism embedded in health care (and other organizations) would likely make these improvements hard to maintain.

Explicit, uncritical racial stereotyping in medicine is one good example. We have known for many years that race is a social construct rather than a proxy for genetic or biological differences. Even so, recent work has identified numerous cases of race-adjusted clinical algorithms in medicine. In nephrology, for example, race adjustments that make it appear as if Black patients have better kidney function than they actually do can potentially lead to worse outcomes such as delays in referral for needed specialist care or kidney transplantation. Other more insidious stereotyping characterizes Native Americans and African-Americans as more likely to be “noncompliant” with diet and lifestyle advice. These characterizations of noncompliance as a function of attitudes and practices completely ignore structural

factors such as poverty, segregation and marketing—factors that create health inequities in the first place.

Meaningful progress at the structural and institutional levels takes longer than a few days of implicit bias training. But there are encouraging examples of individuals who have fought successfully for structural change within their health care organizations. For example, medical students at the University of Washington successfully lobbied for race to be removed as a criterion for determining kidney function—a process that took many years. Their success may have important implications for closing gaps in disparities among patients with renal disease. And innovative new programs such as the Mid-Ohio Pharmacy have linked health care providers with community-based organizations, and help providers address food insecurity among their low-income patients—an issue that disproportionately impacts people of color. (Doctors can write a “food prescription” that allows their patients to purchase fresh produce.)

None of this, of course, means that we should give up on trying to understand implicit bias or developing evidence-based training that successfully reduces discriminatory behaviors at the individual level. What it does mean is that we need to lean into the hard work of auditing long-standing practices that unfairly stigmatize people of color and fail to take into account how health inequities evolve. Creating organizations that value equity and ultimately produce better outcomes for people of color will be long, hard work, but it's necessary, and it's been a long time coming.

Katherine D. Kinzler is a professor of psychology at the University of Chicago. She is author of *How You Say It: Why You Talk the Way You Do and What It Says about You*.

BEHAVIOR & SOCIETY

Were French People Born to Speak French?

No. The belief that people are suited to speak particular languages by biology is widespread—but wrong

Linguistic anthropologists have observed that people all over the world perceive languages, and speakers of those different languages, as fundamentally different from one another. When people listen to others' speech, they hear discrete categorical boundaries even when differences in speech exist along a continuum. Our minds, and not just our ears, perceive these differences: we think of language X as being fundamentally different from language Y. From there, it is not a big leap to think of groups of speakers as being essentially different from one another: speakers of X are fundamentally different from speakers of Y.

You might assume that people are unconsciously conflating language with culture. After all, if someone speaks French fluently, they most



likely come from France, where they were raised immersed in French culture. If that's the case, people's attitudes toward language could simply be a proxy for their attitudes toward perceived cultural differences across groups. But research suggests that people's intuitions and misperceptions about the social life of language run much deeper than this and manifest themselves in some surprising ways.

Indeed, people essentialize language. Psychological essentialism is the notion that particular

groups of people are different because of some real, meaningful underlying essence that is present deep in their nature and often biological in origin. So if you think that French speakers are fundamentally different from English speakers because of something about their essential nature or the biology they were born with—rather than the situational or cultural variable of having lived and been exposed to French rather than English—you are using essentialist reasoning. This common but misleading mental

habit shapes our thinking in many domains.

What's more, as a reflection of this essentialist thinking, it's not uncommon for people to think that when you learn a new language, you may instantly learn a new set of beliefs, ideas or customs. As Harvard University literature professor Marc Shell writes, "Many people maintain that they cannot change their language without ipso facto also changing their gods and themselves." Brandeis University anthropologist Janet McIntosh calls this "linguistic transfer"—the idea that by speaking a new language, you—perhaps suddenly and somewhat mystically—take on the psychic properties of people who speak that language. She has studied this phenomenon in Kenya, where some people report that language defines their selves, their rights, their land and their religion—and they say that learning to speak a new language could risk changing any of these.

One place where this essentialist thinking can often lead us to societal trouble is when we assume that the language of certain members of a group is "pure"—that is, it has a unique characteristic essence—and that some people may be "less pure" group members than others, based on how they speak. In short, people may infer that you can't be an authentic member of a group or a culture without speaking the relevant language in a certain way.

You don't need to go that far from home to see linguistic essentialism in action. Soon after World War I, the Supreme Court of Nebraska upheld a law asserting that "languages, other than the English language, may be taught as languages

“Many people maintain that they cannot change their language without ipso facto also changing their gods and themselves.”

—*Marc Shell*

only after a pupil shall have attained and successfully passed the eighth grade." The justices wrote that speaking a foreign language could "naturally inculcate in [children] the ideas and sentiments foreign to the best interests of this country." Fortunately, the state's law was subsequently overturned by the U.S. Supreme Court in *Meyer v. State of Nebraska* (1923).

People feared teaching a child a foreign language because it seemed the child's mind might as a result take on anti-American ideas. In East Africa, the American Midwest or apparently anywhere in the world, the underlying assumption seems to prevail: what you know—and perhaps the way you feel or think—is somehow embedded in your language. Learning a new one could transfer a set of new ideas into your head.

To put it mildly, people have some funny beliefs about language imbuing speech with mystical powers that in fact having nothing to do with the way we talk. This peculiarity extends to our beliefs about how languages are acquired—and our assumptions about whether languages are learned through hearing people talk to us or by other, more "essentialist" means.

If you've read this far, you won't be surprised to

hear that humans have the biological faculty to learn and reproduce languages, and children learn languages that they hear in their environment. Yet sometimes people seem to think that the ability to speak a particular language, rather than a different one, is embedded in a person's nature, rather than learned from exposure to it.

To illustrate the absurdity—and long history—of this notion, linguists often retell the ancient story of the Greek historian Herodotus, who in about the fifth century B.C. wrote about an ancient psycholinguistics experiment. Allegedly, the Egyptian king Psammetichus wanted to figure out which language was the true first language on earth, the one that most perfectly reflected the human soul: Was it Phrygian or Egyptian? According to the story, he separated two babies from their mothers and sent them to be raised by herders. The babies' physical needs were to be met, but no language was to be spoken in their presence. Lo and behold, as toddlers, they were overheard speaking their first words in Phrygian, the true language of humanity!

Presumably, the babies did not learn the Phrygian language on their own. Maybe the herders spoke Phrygian among themselves, didn't follow

instructions and talked to the babies, exposing them to the language. Or maybe the story is made up. Whatever the case, Herodotus's tale reflects our intuition that the ability to speak one language instead of another is somehow rooted in biology and that a child might inherit it.

In the real world, as we've seen, children are born with the remarkable ability to learn languages—but no child is born with the aptitude to speak any one in particular. Logically, speaking English rather than French, or Spanish rather than Japanese, could not possibly be codified in your DNA. It is rare to find an absolute truth in just about any field of study, but I will go out on a limb and say that if you are not exposed to French, there is about a zero percent chance that you will learn it.

But that doesn't put the kibosh on the strange intuition that speaking one language over another is somehow written into the genetic code. As Steven Pinker writes in his seminal book *The Language Instinct*, which examines humans' remarkable language-learning abilities, this belief is widespread but utterly false:

"This folk myth is pervasive, like the claim of some French speakers that only those with Gallic blood can truly master the gender system, or the insistence of my Hebrew teacher that the assimilated Jewish students in his college classes innately outperformed their Gentile classmates. As far as the language instinct is concerned, the correlation between genes and languages is a coincidence. People store genes in their gonads and pass them to their children through their

Does the hypothetical child grow up to speak the language of her birth parents, which would mean that language is biologically transferred? Or does she instead speak the language of her adoptive parents, which would mean that language is learned from the environment?

genitals; they store grammars in their brains and pass them to their children through their mouths."

Now, you might not need to be convinced that language is passed, as Pinker says, from people's mouths, not their gonads. I have, however, observed that even enlightened modern adults, young and old alike, sometimes think of others as defined by and linked to their native tongue or to the native tongue of their biological forbears.

A colleague of mine is a psychology professor at a large university. In a particular class, she spends a day teaching about language acquisition, typically mentioning research on international adoptions, such as studies of Korean children adopted by French families, who grow up to speak French (and not Korean). She says it does not happen frequently, but every so often a student will express surprise that an ethnically Asian child could learn French so well. When asked to explain their thinking, they offer the opinion that someone who is ethnically Asian would have an easier time learning a "typically Asian" language; French was better suited to white children. In truth, any child can learn any language; it's just

a matter of being exposed to it. But some adults hold the mistaken belief that something about your genes specifies which language it would be easier for you to learn—even as a baby.

To give another example, a (white, Midwestern-accented) friend of mine recently told me the following story. Her cousin adopted twin African-American girls, at age one and a half. The cousin had suffered from infertility for years and desperately wanted a baby; when the opportunity arose to have two at once, she was overjoyed. Fast-forward 11 years, and the girls are becoming adolescents. They are rebelling and finding their own footing, like adolescents everywhere. And their quest for self-definition has extended to their speech.

Recently, the twins' mom shared, her daughters sounded different to her. As she struggled to articulate this idea, she mentioned to her cousin (my friend) that she thought they sounded Black. Trying to figure out why their speech had suddenly changed, she mused aloud. Perhaps their biological mom (whom she had never met) had spoken a dialect of African-American English.

Maybe the twins were exposed to this dialect early in life, and it stuck somehow. Or maybe it was transferred in utero or inherited in their DNA? Could that be why, all of a sudden, it sounded like they were speaking differently?

Of course, the answer is that no dialect of English had been handed down in the girls' DNA. This is simply impossible. Dialects (and all languages) are learned via linguistic exposure. For the twins, like for anyone, their changing speech must reflect changing conversations and social role models in their environment. Yet you can see in the mom's thinking linguistic essentialism, clear as day.

Studies of children provide some insight into adults' puzzling intuitions about language and where those languages may come from. Some fascinating evidence suggests that children start out with a pretty naive theory, thinking that learning a specific language (such as French instead of English) comes from biology, not environment. Some adults may hold on to this childhood intuition, even after experience should have debunked it.

In one experiment that nicely demonstrated children's thinking, Susan Gelman and Lawrence Hirschfeld gave Michigan preschoolers a "switched at birth" task. Children learned of two families—the Smiths and the Joneses. One spoke English and the other Portuguese. Now, say the Smiths (the English speakers) have a baby, and the baby immediately goes to live with the Jones family (the Portuguese speakers). When that baby grows up and learns

to talk, will she speak English or Portuguese?

You can see how this experiment cleverly pits children's beliefs about nature and language against the concept of nurture and language. Does the hypothetical child grow up to speak the language of her birth parents, which would mean that language is biologically transferred? Or does she instead speak the language of her adoptive parents, which would mean that language is learned from the environment?

Five-year-old children chose the "biological" answer. Hearing these simple vignettes, they concluded that the hypothetical child would grow up to speak the language of her birth parents, although the child lacked exposure to that language. In jumping to this conclusion, these children are following in the footsteps of the Egyptian king in Herodotus's story—the ruler who thought that by rearing children in linguistic isolation, he could determine their "true" language. It seems that some adults may still hold on to this incorrect childhood intuition about where language comes from—and what this intuition represents.

This essay is adapted from the new book How You Say It: Why You Talk the Way You Do and What It Says about You.

Stay up to date on the latest in psychology and neuroscience

Sign up for our Mind & Brain Newsletter

Sign Up



COGNITION

The Weirdness of Watching Yourself on Zoom

As babies, we learn that it's ourself we see in a mirror. But online meeting rooms are a whole different thing

It is not an easy thing to stare at my Zoom self, meeting after meeting, day after day. This unflattering yawn, that stray wisp of hair I cannot touch again without seeming nervous or vain, these chins. Watching ourselves is exhausting but also compelling. Thinkers both ancient and modern have grappled with why.

Mirrors are strange because they produce the image of another body moving in perfect synchrony with your own—something you never experience otherwise. The radical ubiquity of mirrored surfaces in everyday modern life has trained our ancient brains to use them: to back our cars into the street, to inspect our molars, to shave. This rare experience of perfect synchrony is closely tied to our own (usually unemotional) faces. But observing your perfect double as a



body in action remains, for most people, distracting and awkward. My favorite local restaurant has angled the mirrors behind the tables so that I can enjoy the light and movement they offer but needn't watch myself socialize.

Children realize that a reflected image is themselves by the middle of their second year; at least it takes them until then to reach up to remove an unexpected sticker on their head (rather than move toward the mirror). In the 1880s German physiologist William Preyer, while documenting

every day of his son's early life, paid special attention to the boy's reactions to his own mirror image. At 14 months, the child waved his hand behind the mirror as if searching for another person and four weeks later touched the surface of the mirror itself to do this; at 17 months, he made faces at himself. Preyer thought mirror recognition marked a watershed moment in a child's ability to think of the self as the self—as something independent of the surrounding world, a kind of object distinct from other objects. I exist.

A key piece of recognizing yourself is being able to detect when two things are temporally dependent, or contingent. As early as four months, infants prefer to watch a video clip where the audio and visual streams are synched correctly versus not. At this same age infants begin to prefer slightly imperfect synchrony in their social interactions, exactly the kind you'd expect from a partner, a call and response (some have theorized that it is a continued preference for perfect synchrony that distinguishes children with autism).

Recognizing motion matches between ourselves and others uses the same part of the brain as self-recognition: if she reaches out her arm, the part of my brain that controls my (potential) reach also activates. Italian neuroscientist Giacomo Rizzolatti and his colleagues first saw this “mirror neuron system” in monkeys; our brains, too, reflect the actions of a partner even if we don't actually make the movement. Of course, we sometimes do make the movement, or a small version of it, without even realizing. Try to watch a video of someone else smelling something horrible without moving your face. More than 260 years ago Scottish philosopher Adam Smith commented that it seemed especially true of eyes: if someone else's eyes water, so do our own; if they wince in pain, so do we.

The ancient Roman emperor Marcus Aurelius advised those seeking to live fully to “enter others' minds and let them enter yours.” When you wrinkle your nose, so do I a little, and our brains recognize a kind of micro kinship. Even before

they can walk, infants notice (and prefer) people who imitate them to others who are just playing. Some “mirror neuron” brain areas are especially active when you imitate someone in a mirror style: if you're facing them and they move their right hand, you move your left. This also activates language areas in the brain, maybe because face-to-face imitation is inherently communicative—it helps us understand one another. That colleague nodding enthusiastically in his Zoom square is a pleasure; the “thumbs up” symbol less so.

We may now use our brain for language, but long ago our ancestors coordinated themselves through gesture. This coordination of me and not-me includes distinguishing our own thoughts from other people's, a skill that also uses those same brain regions but takes a bit longer to hone. Your preschooler is still struggling with understanding how someone could think in their head something different than what is true in the world. That's why she needs you to explain why she can't nod “yes” during a phone conversation or why you've spent 20 minutes looking for shoes that she knew perfectly well (but didn't mention) were already in the car.

So, the challenges of live self-stream.

First, the nonmirror-style self. For example, I have a freckle under my left eye. In my mirror, it appears on the left side of space (that is, under the mirror-person's right eye), and that's how I'm used to it. If you're looking at me, it appears to you on the right side of space. Thankfully, Zoom now handles this weirdness for us: I see myself

mirror-style, but for you I'm flipped. Many phones also have this built in, so we can say “yes, there's me” to a selfie rather than “ugh.”

Second, you've been practicing perfect self-contingency detection (you feel your arm moving while you see it moving) since you were two months old. Now you feel your arm move and see it move slightly later. No wonder you can't tear your eyes from yourself.

Third, that slight asynchrony we like between ourselves and others is unpleasantly magnified by glitchy Wi-Fi. Research shows that a response delay of as little as 1.2 seconds disrupts your feeling of connection with another person. You can't read them, they can't read you—are they laughing with you or at you?

Fourth, it's a documented phenomenon that people overattribute emotionality to their own neutral faces. We're accurate in recognizing neutral expressions on other faces but tend to “see” expressions in our own; when we do, we misidentify our expression as negative the great majority of the time.

Laboring away under the frowning, slightly askance gaze of your own, slightly delayed self, and without those perfectly imperfect microimitation asynchronies we're built to crave—it's exhausting work.

Emily Willingham, Ph.D., is a science writer and author of *Phallacy: Life Lessons from the Animal Penis* (Avery, an imprint of Penguin Random House, 2020).

BEHAVIOR & SOCIETY

Penis Size Has Nothing to Do with Masculinity

Mocking men who tote big guns or drive fast cars as “compensating” for their presumably inadequate endowment is sexist and toxic



In this age of open discussion about the penises of a supreme court justice and the nation’s president, perhaps it’s no surprise that people as freely try to draw parallels between a man’s behaviors and the size of his penis.

Many of us have seen—and perhaps had—a similar response to seeing images of a man swaggering around in Starbucks with an AR-15 slung over his back: “Oh, look at that loser—he must be compensating for something, ha ha.” If you’ve spent time on social media, you’ll see plenty of people who have this reflexive snarky response. It reduces the target to a penis that’s “too small,” instead of grappling with the ominous and dangerous social pressures and thinking that drive the behavior.

What these people, many of whom who likely view themselves as “progressives,” don’t seem to

realize is that their sexist mockery draws from the same toxic well poisoning the minds of people who carry a semiautomatic to buy overpriced coffee.

Instead of reflexive jeering, we should be working on an antidote to this poison, directly addressing the causes of toxic masculinity overload and ways to drain it from our society.

The first step is to acknowledge that a fear of rejection and a need for acceptance—by social groups, romantic interests, people in power—is the main ingredient. Toting a huge gun and indulging in knee-jerk mockery of penis size both reflect this fear in different ways. A man carrying a ballistic weapon openly in a coffee shop isn’t doing that because he’s afraid of the people in the store. He’s doing it to claim bragging rights for his in-group, the people he expects will backslap him and say

“bro” approvingly when he describes his adventure. Positive responses that pour in from like-minded strangers on social media, if someone posts about his antics, are even better. The negative responses? Those just reinforce his affiliation with the group that approves.

Speaking of social media, I occasionally hear from men who are not, shall we say, fans of my writing about masculinity—critiques that they invariably express using sexist terms. I do not like to magnify the voices of people who throw around such slurs, so I don’t publicly respond to their comments. But I will share them occasionally on Facebook, with settings such that only friends can see them. A gal’s gotta have an outlet.

Almost invariably, some of the people who comment—who are, I add, there to bemoan the toxic

anger and sexist attacks—will mention something about the critic’s penis size and how his behavior suggests compensation for having a smaller-than-average one. They will also frequently anathematize the fellow, reducing him to a vulgar epithet for a body part. In doing so, they are letting me and everyone on these comment threads know that they deplore this sexist behavior. As much as I truly appreciate their support (I do!), it’s inescapable that their comments are sexist, too. I’ve fallen into this language trap, as well, so I work on trying to avoid it.

The motivations and underlying factors are similar for the gunslingers and the size slappers: a signal of support and for approval, poisoned by the seeping influence of toxic masculinity. Understanding these motivations and consciously avoiding these sexist traps is one antidote to that poison.

The second step is working to change these rules of acceptance and reduce the accompanying fear of rejection. Like all effective communication around change, the messaging must come from trusted voices within our social circles and from the blessed younger generations rewriting the rules about what masculinity looks like.

The Western version of swaggering masculinity takes its cues from what the American Psychology Association (APA) calls “masculinity ideology.” In this construct, expressing masculinity means rejecting any accoutrements or behaviors that might suggest femininity or “weakness,” both of which are vague concepts that could use some sociocultural repositioning. Masculinity ideology also calls on its practitioners to show a willingness

to take risks and evince a propensity to violence, both of which, interestingly enough, also could be construed as weaknesses.

In 2018, after yet another U.S. school shooting, comedian and actor Michael Ian Black wrote a lament about the toxicity of this ideology, the poison of “toxic masculinity,” which I think of as “impossible masculinity.” He wrote: “There has to be a way to expand what it means to be a man without losing our masculinity. I don’t know how we open ourselves to the rich complexity of our manhood.”

There is a way.

We dispense with the fearful voices in this society, those who reinforce the idea that achieving impossible masculinity is the grand prize trophy for being a “real” man. We can join the growing numbers of people who, like the APA, recognize not just a single masculinity but an array of masculinities.

These new versions of masculinity are bursting through the weak points in the rigid, Westernized iteration. The real secret for someone wondering who he is or who he should become in the context of masculinity isn’t buried in Jordan Peterson’s *12 Rules for Life*, manifested in Ayn Rand’s Howard Roark or delineated in an Esquire profile of a single middle-class white boy. A boy or young man doesn’t need to follow a predetermined path to finally receive his Certificate of Manhood at the end of the road. There are many ways to be “masculine,” so much so that perhaps the term itself should be packaged up and boxed away and some fresher array of nouns adopted in its place.

An important final step in the antidote mix against impossible masculinity is to stop conflating

human beings with their genitalia. We use slang terms for penises to slur men whose behavior is, in fact, a performance of this very masculine ideology society imposes on them: violent, risk taking, “powerful” and not feminine. Reducing their behavior to “compensation” for the size of their penises is an easy out, a gambit that lets us look away from the forces that drive these men to perform like this for their in-crowd.

Their audience openly embraces these dictates of masculinity ideology and explicitly celebrates and approves them. The progressives who attribute the behavior to low self-esteem about the penis are more slyly using those dictates to embrace the same ideology. They are reducing to a penis the complex social forces and decision points that drive these men to believe and behave as they do. This conflation of the person with the body part has never worked out well for society, whether as a Freudian-inspired take that mothers were treating their babies as phalluses or the eternal interest in the fate of a penis detached from a man guilty of partner violence, rather than in the fate and mental health of the abused partner.

We need to look to the whole person, not the pelvic region, and use what we have north of that area to dismantle these moldy conceptualizations of masculinity. Penis size doesn’t matter, and it’s not the measure of the man.

Stephen Macknik and **Susana Martinez-Conde** are professors of ophthalmology at the State University of New York and the organizers of the Best Illusion of the Year Contest. They have co-authored *Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions* and *Champions of Illusion: The Science behind Mind-Boggling Images and Mystifying Brain Puzzles*.

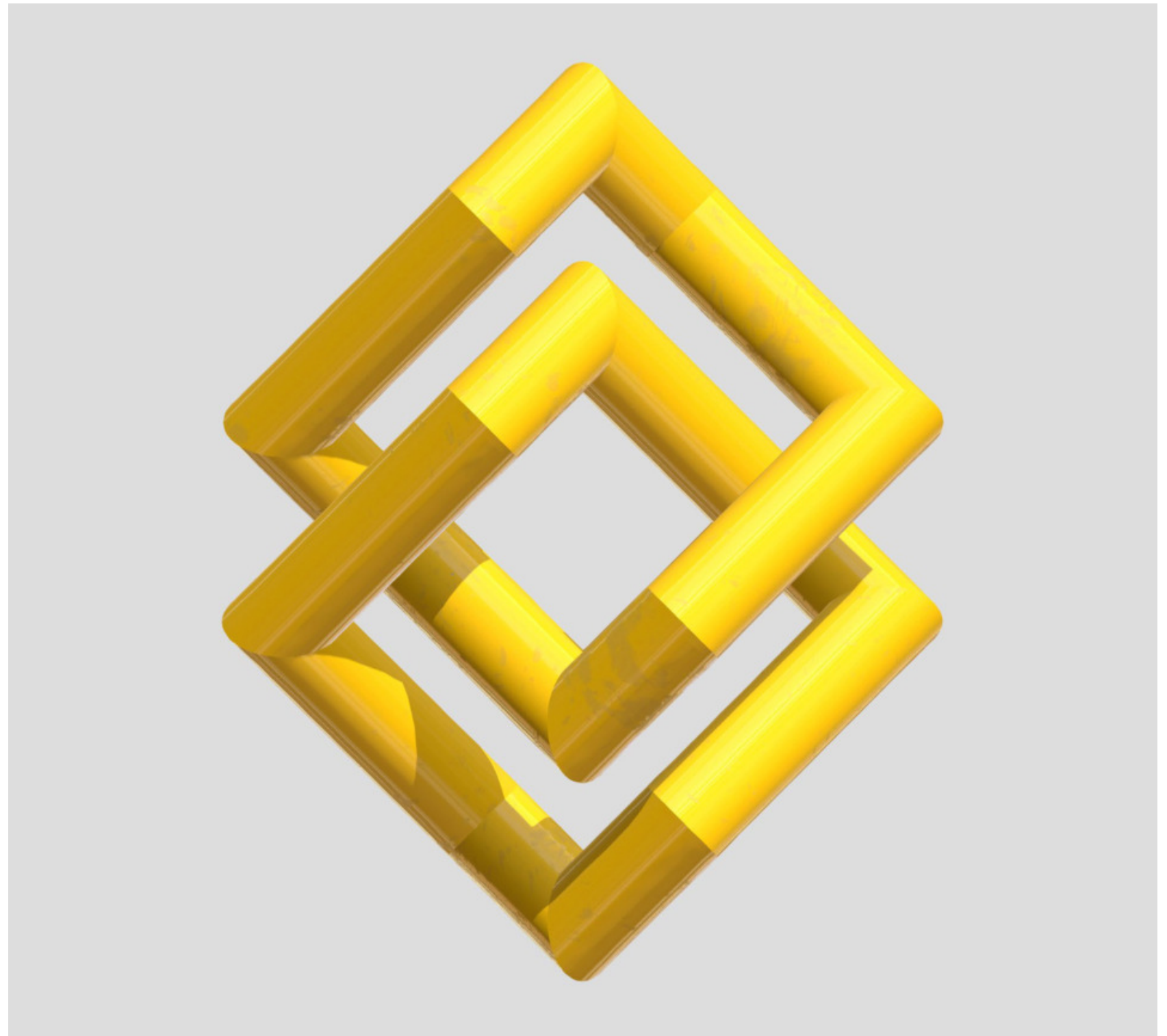
Perplexing Perspectives

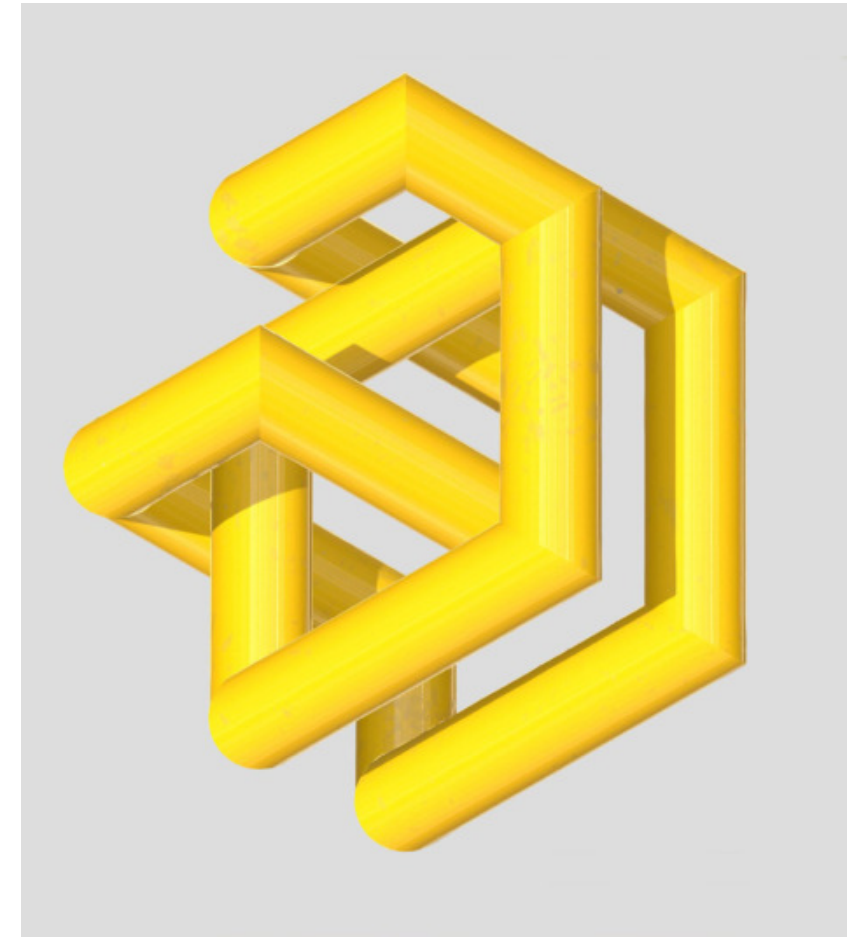
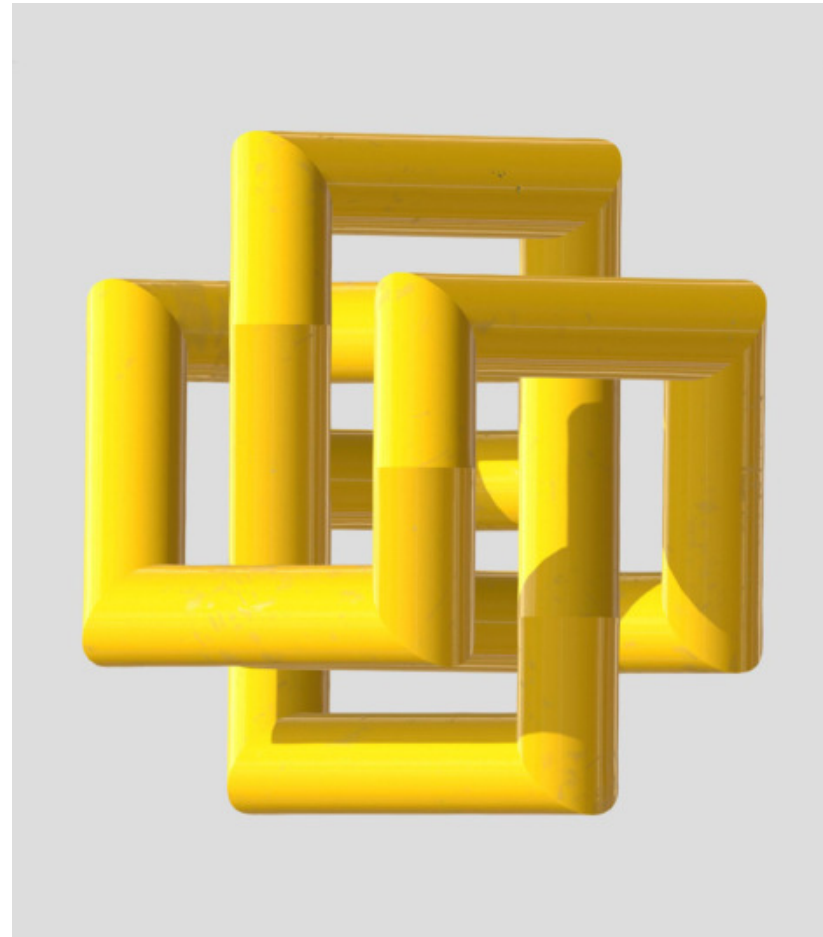
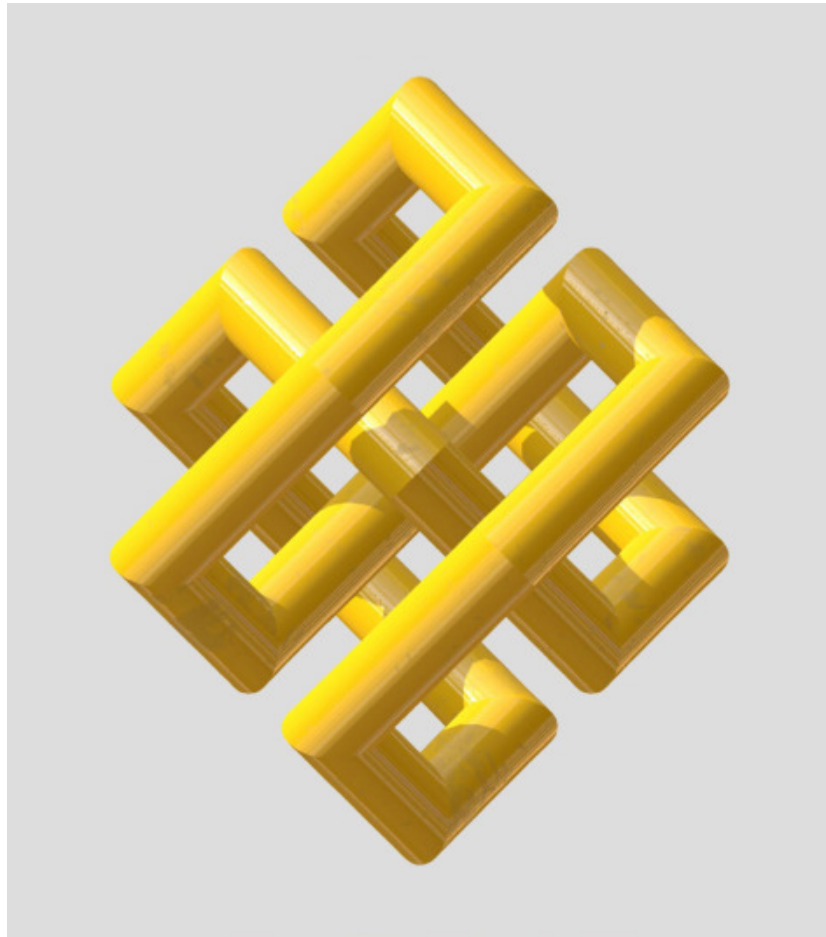
Conflicting viewpoints coexist at the crossroads of math and art

In Plato's allegory of the cave, chained prisoners face a blank cavern wall from the time they are born, the only reality they have ever known. When people and objects passing behind the captives project shadows on the wall, the prisoners believe that their experience of the world is complete, never realizing that their knowledge is impoverished to a vast degree.

A new virtual art exhibit, which is being hosted by the National Museum of Mathematics in New York City, highlights how, whenever we examine a three-dimensional item from a single vantage point, we can only ever observe a partial projection, or shadow, of the entire object in front of us. Because we experience the 3-D world around us through the filter of our 2-D retinas, our visual experience is sometimes no better than that of the unfortunates in Plato's cave.

The intellectual heir of Dutch graphic artist M. C. Escher, Anton Bakker is a contemporary





Opus 125707, by Dutch sculptor Anton Bakker. Each image represents a different perspective of the same 3-D object.

artist exploring the intersection of math, art and illusion. Influenced by Escher’s unique approach to perspective, Bakker uses computer-based methods to find unexpected and ambiguous viewpoints within cubic lattices and polyhedra. “Everything that exists, every piece of matter, is built from these structures,” says Bakker about cubic lattices, which form the basis of the most stable molecular forms of many elements. “I get goosebumps when I pursue a hunch about what exists in a lattice and discover an illusion of stunning beauty.”

Bakker’s mathematical sculptures—whether rendered in steel, bronze or virtually—underscore how different takes on the same lattice can change the apparent reality of the structure, revealing the “multiplicity of perspectives inherent in all things.” The overarching principle is not exclusive to Bakker’s creations, but a fundamental problem in everyday vision, where our brains must resolve profoundly ambiguous incoming information into one of many possible perceptual solutions.

“The brain thinks it sees two linked squares

[from a certain viewpoint],” says Bakker about his *Opus 125707*, featured here. Without studying the other perspectives, viewers may walk away with a false interpretation about the simplicity of the structure they think they have seen. Yet the reality is far more complex than revealed by that first, accidental view—and there are lots more such riddles to discover, hidden in the lattices.

“I’ve been playing in this sandbox for 40 years and I will continue to play in it for the rest of my days,” Bakker says.

SCIENTIFIC AMERICAN MIND

Editor in Chief: **Laura Helmuth**
Managing Editor: **Curtis Brainard**
Senior Editor, Collections: **Andrea Gawrylewski**
Chief Features Editor: **Seth Fletcher**
Chief News Editor: **Dean Visser**
Chief Opinion Editor: **Michael D. Lemonick**
Creative Director: **Michael Mrak**
Issue Art Director: **Lawrence R. Gendron**
Photography Editor: **Monica Bradley**
Assistant Photo Editor: **Liz Tormes**
Photo Researcher: **Beatrix Mahd Soltani**
Copy Director: **Maria-Christina Keller**
Senior Copy Editors: **Angelique Rondeau,**
Daniel C. Schlenoff, Aaron Shattuck
Copy Editor: **Kevin Singer**
Managing Production Editor: **Richard Hunt**
Prepress and Quality Manager: **Silvia De Santis**
Product Manager: **Ian Kelly**
Senior Web Producer: **Jessica Ramirez**
Editorial Administrator: **Ericka Skirpan**
Executive Assistant Supervisor: **Maya Hartly**

President: **Dean Sanderson**
Executive Vice President: **Michael Florek**
Vice President, Magazines, Editorial and Publishing: **Stephen Pincock**
Vice President, Commercial: **Andrew Douglas**
Senior Commercial Operations Coordinator: **Christine Kaelin**
Rights and Permissions Manager: **Felicia Ruocco**

LETTERS TO THE EDITOR:

Scientific American, 1 New York Plaza, Suite 4600, New York, NY 10004-1562, 212-451-8200 or editors@sciam.com.

Letters may be edited for length and clarity. We regret that we cannot answer each one.

HOW TO CONTACT US:

For Advertising Inquiries: Scientific American, 1 New York Plaza, Suite 4600, New York, NY 10004-1562, 212-451-8893, fax: 212-754-1138

For Subscription Inquiries: U.S. and Canada: 888-262-5144, Outside North America: Scientific American, PO Box 5715, Harlan IA 51593, 515-248-7684, www.ScientificAmerican.com

For Permission to Copy or Reuse Material From Scientific American: Permissions Department, Scientific American, 1 New York Plaza, Suite 4600, New York, NY 10004-1562, 212-451-8546, www.ScientificAmerican.com/permissions. Please allow three to six weeks for processing.

Copyright © 2020 by Scientific American, a division of Springer Nature America, Inc. All rights reserved.

Scientific American is part of Springer Nature, which owns or has commercial relations with thousands of scientific publications (many of them can be found at www.springernature.com/us).

Scientific American maintains a strict policy of editorial independence in reporting developments in science to our readers. Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

From Genius to Madness

Neuroscience, human behavior, mental health
6 issues per year · Read anytime, anywhere

sciam.com/mind-digital

