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WHY SOME MEN REFUSE TO WEAR MASKS

REPRIORITIZE YOUR GOALS TO UP PRODUCTIVITY

PSYCHEDELIC USE ON THE RISE

WITH COVERAGE FROM nature

LIZ TORMES

New Views of our Mesmerizing, Maddening Minds

It's one of my favorite events in the science world: the annual Art of Neuroscience contest held by the Netherlands Institute for Neuroscience. Now in its 10th year, the competition looks a lot different than it did even five years ago. Yes, many entries still show off the vivid and fantastical microscopic images of the brain stained in rainbow colors. But thanks to more sophisticated technology, more submissions each year use interactive digital features to create immersive experiences for the viewer. When these types of installations first began appearing in the contest, I bristled a bit (though I am not now proud to admit it). I love the mesmerizing effect of using fluorescent protein tags that illuminate neural cells, for example, or the cilia of the inner ear, which made up the bulk of entries years ago. These images are quite like modern art you'd see in a museum. But just as the brain is more than a corporeal lump of flesh, so the art of neurology is more than a static image. The new generation of brain science art engages the viewers' own brains as part of the experience—and sometimes in a full sensory immersion, as you can see in some of the entries we've featured in this issue (see "The Beautiful Things Inside Your Head: Winners of the 10th Annual Art of Neuroscience Contest").

In this issue's cover story, social psychologist Scott Barry Kaufman examines some of the debilitating tendencies of those with a victim mindset, and he offers a powerful new paradigm for how to shift into a personal growth mode and get the most out of your life (see "Unraveling the Mindset of Victimhood"). Our heads are filled with beautiful and strange things, whether one or the other depends on how you look at them.

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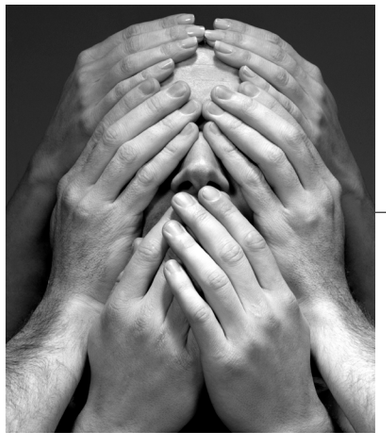
On the Cover

Focusing on grievances can be debilititating; social science points to a better way



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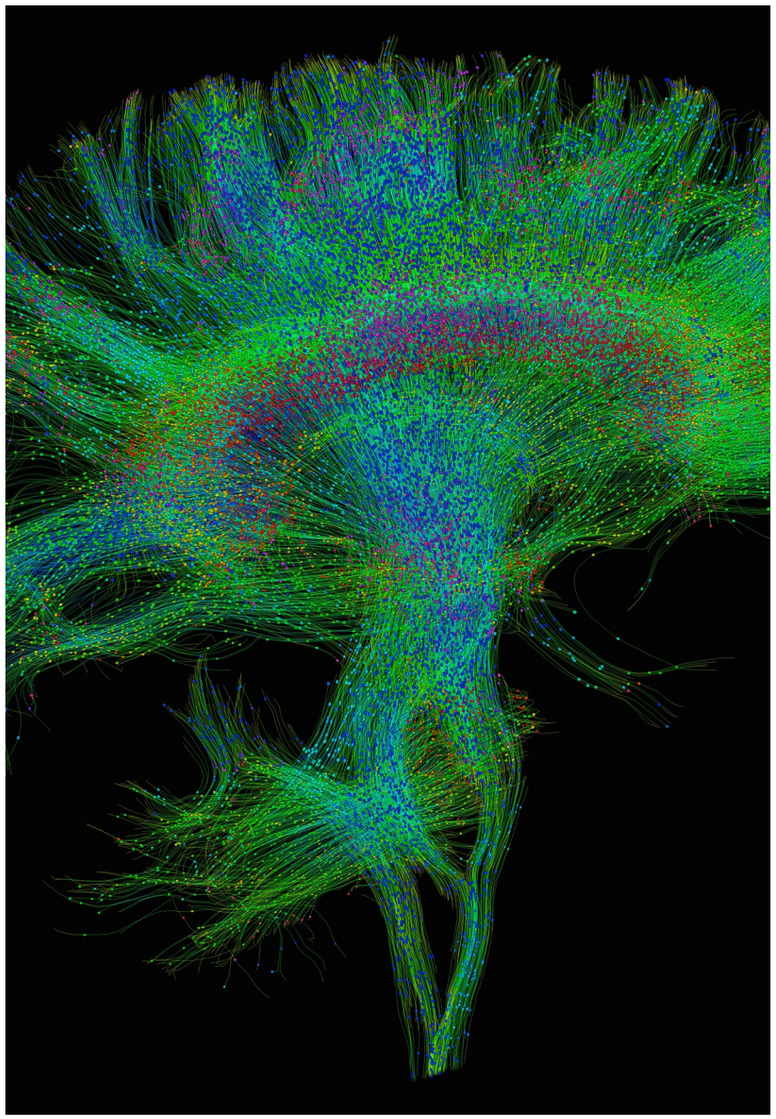

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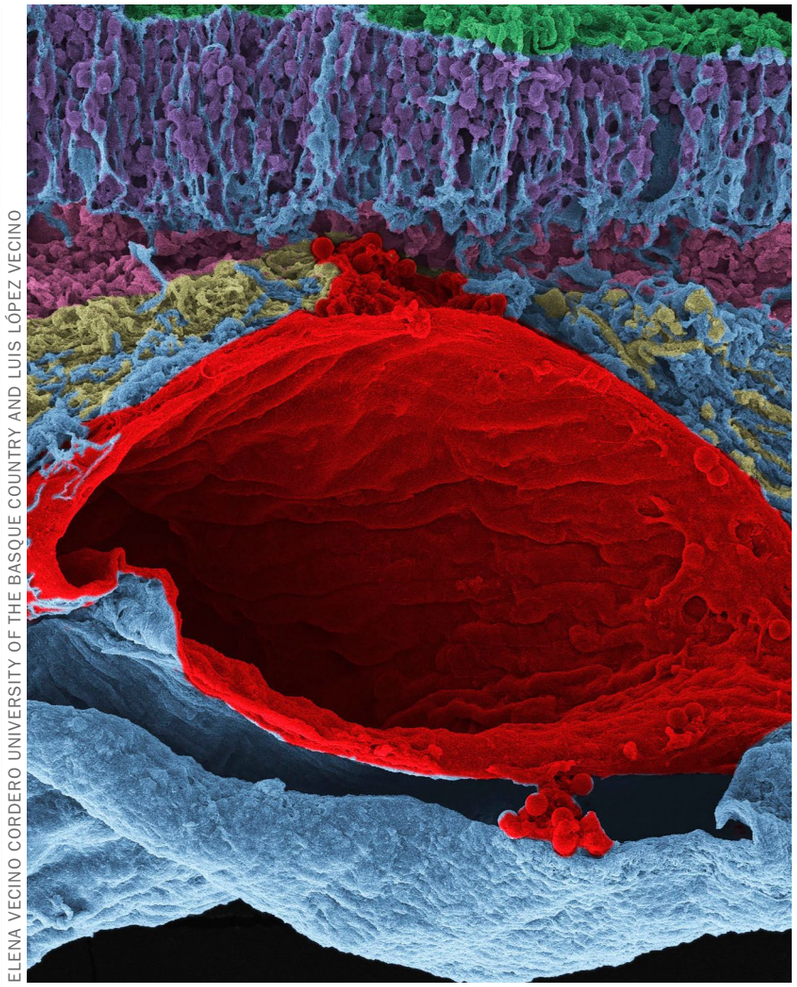

ELENA VECINO CORDERO UNIVERSITY OF THE BASQUE COUNTRY AND LUIS LÓPEZ VECINO

NEWS

Why Do People Avoid Facts That Could Help Them?

Several studies suggest that individuals widely prefer to remain ignorant about information that would benefit them when it's painful—and sometimes when it's pleasurable

In our information age, an unprecedented amount of data are right at our fingertips. We run genetic tests on our unborn children to prepare for the worst. We get regular cancer screenings and monitor our health on our wrists and our phones. And we can learn about our ancestral ties and genetic predispositions with a simple swab of saliva.

Yet there is some information that many of us do not want to know. A study of more than 2,000 people in Germany and Spain by Gerd Gigerenzer of the Max Planck Institute for Human Development in Berlin and Rocio Garcia-Retamero of the University of Granada found

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that 90 percent of them would not want to find out, if they could, when their partner would die or what the cause would be. And 87 percent also reported not wanting to be aware of the date of their own death. When asked if they would want to know if, and when, they'd get divorced, more than 86 percent said no.

Related research points to a similar conclusion: we often prefer to avoid learning information that could cause us pain. Investors are less likely to log on to check their stock portfolios on days when the market is down. And one laboratory experiment found that subjects who were informed that they were rated as less attractive than other participants were willing to pay money not to find out their exact rank.

More consequentially, people avoid learning certain information related to their health even if having such knowledge would allow them to identify therapies to manage their symptoms or treatment. As one study found, only 7 percent of people at high risk for Huntington's disease elect to find out whether they have the condition, despite the availability of a genetic test that is generally paid for by health insurance plans and the clear usefulness of the information for alleviating the chronic disease's symptoms. Similarly, participants in a laboratory experiment chose to forgo part of their earnings to avoid learning the outcome of a test for a treatable sexually transmitted disease. Such avoidance was even greater when the disease symptoms were more severe.

Emily Ho, now at Northwestern University, and her colleagues recently developed a scale to measure people's relative aversion to potentially unpleasant but also potentially useful information. (You can learn about your own tendency to avoid information here.) The researchers presented 380 participants with various scenarios designed to test their desire to know across three domains (personal health, finances and other people's perceptions of them), with each scenario presenting the possibility of a favorable or unfavorable outcome for the participant. Scenarios included subjects learning their risk for a particular medical condition, finding out the performance of an investment opportunity they missed and knowing the truth about how well a speech they gave went.

Information avoidance can be a problem, of course, if it keeps us from learning things that would help us make smarter choices.

The seriously information averse were a minority, though a substantial one: On average, participants reported that they would definitely or probably not want to receive such information 32 percent of the time. About 45 percent would avoid finding out how much they would have gained by choosing a more profitable investment fund in the past; 33 percent would prefer not to know what someone meant when describing them as quirky; and 24 percent would not want to be aware of whether a friend liked a book they had given that person as a birthday gift.

The researchers also documented personal characteristics of the participants, some of which proved to be significant variables. Although the degree to which people wanted to avoid information was not associated with gender, income, age or education, subjects who were more extroverted, conscientious and open to new experiences were more prone to seek out such information. Meanwhile those with high neuroticism scores showed the opposite tendency. (Among those who were more open to such information, there was often at least one domain in which they opted to remain uninformed.) In a second study, participants rated the same series of scenarios twice, four weeks apart. Their responses remained stable over time.

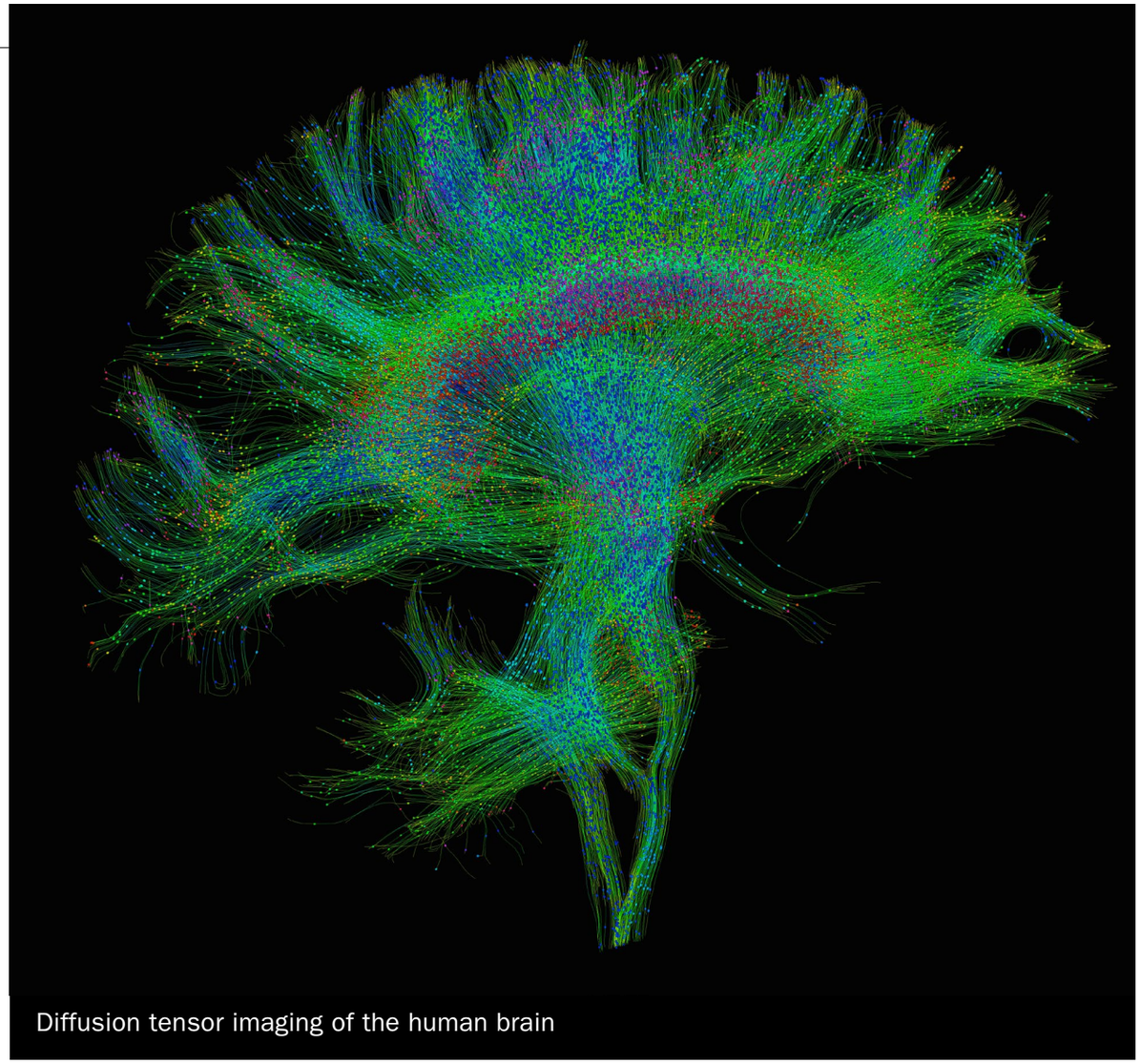
Not surprisingly, Ho and her team found, the motivation to avoid information impacts our behavior. In one of their experiments, participants completed the initial survey on knowledge avoidance. Two weeks later they had the option to visit a Web site with potentially valuable information that they might find painful to learn. For instance, one site compared the average salaries of men and women across occupations. Another contained health data about people's individual risk of burnout. Participants' tendency to avoid information, as measured by the initial survey, correlated with their avoidance of such Web sites.

This general body of research suggests that deliberate ignorance is a widespread preference not only in relation to painful news and events such as death and divorce but also in pleasurable ones such as birth. When Gigerenzer and Garcia-Retamero asked their 2,000-plus participants if they wanted to learn about positive life events, most preferred ignorance over knowledge. More than 60 percent indicated not wanting to know about their next Christmas present. And about 37 percent said they would prefer not to find out the sex of their unborn child. This result might have something to do with the possibility of disappointment, but the bigger issue, this research shows, is that people enjoy the suspense.

Information avoidance can be a problem, of course, if it keeps us from learning things that would help us make smarter choices (those regarding our health, for example, or our finances). But declining to learn available information does allow us to forgo some of the suffering that knowing the future may cause—and to enjoy the sense of suspense that pleasurable events provide. There seems to be some magic in the maybe. —*Francesca Gino*

How Human Brains Are Different: It Has a Lot to Do with the Connections

Different mammals demonstrate common patterns in brain connections. But our own species has a few twists of its own



Diffusion tensor imaging of the human brain

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What makes the human brain special? That question is not easy to answer—and will occupy neuroscientists for generations to come. But a few tentative responses can already be mustered. The organ is certainly bigger than expected for our body size. And it has its own specialized areas—one of which is devoted to processing language. In recent years brain scans have started to show that the particular way neurons connect to one another is also part of the story.

A key tool in these studies is magnetic resonance imaging (MRI)—in particular, a version known as diffusion tensor imaging. This technique can visualize the long fibers that extend out from neurons and link brain regions without the need to remove a piece of skull. Like wires, these connections carry electrical information between neurons. And the aggregate of all these links, also known as a connectome, can provide clues about how the brain processes information.

A persistent question about connectomes is what, if anything, distinctive wiring patterns have to do with the evident cognitive differences between a mouse, a monkey and a human. A new methodology called comparative connectomics has identified some general rules of brain wiring across species that may help provide answers. In the meantime, it has also found some unique facets of the human connectome and discovered changes in the cells charged with the upkeep of brain

wiring. Together these evolutionary innovations seem to keep information flowing efficiently through a large human brain. And when they are disrupted, they may give rise to psychiatric disorders.

Hypothetically, the most efficient connectome would follow a one-to-many design, with each nerve cell connecting to all of the others. But this approach is prohibitively unworkable because it requires a lot of space to house all these connections and energy to keep them functioning. Alternatively, a one-to-one design in which each neuron connects to only a single other neuron would be less challenging—but also less efficient: information would have to traverse enormous numbers of nerve cells like stepping-stones to get from point A to point B.

"Real life is in the middle," says Yaniv Assaf of Tel Aviv University, who published a survey of the connectomes of 123 mammalian species in *Nature Neuroscience* in June. Assaf came upon his research in a somewhat roundabout way: What began as a weekend hobby of imaging bat brains with his Tel Aviv colleague Yossi Yovel turned into a seven-year-long exploration of as many post-mortem mammalian brains as they could borrow from a nearby veterinary institute. The investigators looked at a variety of the organs, from the smallest bat brain, which required a magnifying glass to inspect, all the way to the human heavyweight. In between those examples were the brains of giraffes, honey badgers and cows. Among all of them, the team found the same patterns of connections at work: the number of stepping-stones to get from one place to another was roughly the same in each of the organs. Differing brains used similar wiring designs.

There were some differences in how this arrangement was achieved, however. Species with few long-range connections linking the two hemispheres of their brain tended to have more short connections within each hemisphere in which nearby areas "talked" intensively with each other. Species with more long-range connections, such as humans and other primates, thinned out these local networks.

This approach to connectivity may reflect geometric constraints on packing a nervous system into a skull. But variations in these links within a species might also track with different abilities. "If you have denser connectivity in one region, you might have a certain ability others wouldn't," Assaf says.

Although human brains follow the mammalian connection game plan, they also show some striking innovations. In a head-to-head comparison of human connectomes with those of chimpanzees, our closest living relatives, published last year, Martijn van den Heuvel of Vrije University Amsterdam and anthropologist James Rilling of Emory University revealed 33 human-specific connections. These unique links were longer and more important to network efficiency than 255 connections that were shared in the two species. The distance-spanning connections also tied together high-level "associative" areas in the cortex that are involved in language, tool use and imitation.

"The human brain tends to have a higher investment in keeping those associative areas connected," van den Heuvel says. This setup could enable efficient integration of information from different parts of the brain, particularly those tasked with conceptual processing. "I think this investment has brought us our more complicated brain functions," he adds.

When van den Heuvel and his colleagues looked at language areas, a "connectivity fingerprint" popped out. Chimps have their own limited versions of Broca's and Wernicke's areas, the regions responsible for human language production and comprehension, respectively. But in humans the connections between the two are stronger. And the connections from Broca's area to other regions of the brain are actually weaker. It is as though the two regions have dedicated their processing might to each other and thus set the stage for language.

The human-specific connections may form an Achilles' heel for humans, however. In a study published last December, van den Heuvel, Rilling and their colleagues found that human-specific connections were more disrupted in schizophrenia. "This raises the possibility that the evolution of these novel human connections came with a cost," Rilling says.

Although these studies argue for the evolutionary importance of brain connections, the imaging methods are not without mistakes. They have limited resolution, so they may miss a connection's ending or taking a turn.

This problem means the field needs to draw from other areas of evidence to firm up the findings, says Christine Charvet, an assistant professor at Delaware State University, who studies human brain evolution and was not involved in the papers.

Genomics can fill in some of the gaps. A study published in January focused on DNA segments called enhancers, which control whether genes are turned on or off. Menno Creyghton of the Erasmus University Medical Center in the Netherlands and his colleagues found that certain enhancers in humans and chimps differed significantly from those in more distantly related macaques and marmosets. This genomic remodeling took place in cells called oligodendrocytes, which wrap connections with insulating sheaths of protein. Doing so ensures that electrical signals quickly reach their destination.

Creyghton suggests that the cells are trying to catch up to brain expansion. "These oligodendrocytes need to reinvent themselves to facilitate this larger brain," he says. "So you have this one spectacular change that gives you a larger brain. And then you need lots of adaptations in the brain to cope with that." —*Michele Solis*

YANG LIU GETTY IMAGES

Music Synchronizes the Brains of Performers and Their Audience

The more people enjoy music, the more similar their brain activity is to that of the musicians

When a concert opens with a refrain from your favorite song, you are swept up in the music, happily tapping to the beat and swaying with the melody. All around you, people revel in the same familiar music. You can see that many of them are singing, the lights flashing to the rhythm, while other fans are clapping in time. Some wave their arms over their head, and others dance in place. The performers and audience seem to be moving as one, as synchronized to one another as the light show is to the beat.

A new paper in the journal *NeuroImage* has shown that this synchrony can be seen in the brain activity of the audience and the performers. And the greater the degree of synchrony, the study found, the more the audience enjoys the performance.

This result offers insight into the nature of musical exchanges and demonstrates that the musical experience runs deep: we dance and feel the same emotions together, and our neurons fire together as well.

In the study, a violinist performed brief excerpts from a dozen different compositions, which were videotaped and later played back to a listener. Researchers tracked changes in local brain activity by measuring levels of oxygenated blood. (More oxygen suggests greater activity because the body works to keep active neurons supplied with it.) Musical performances caused increases in oxygenated blood flow to areas of the brain related to understanding patterns, interpersonal intentions and expression.

Data for the musician, collected during a performance, were compared with those for the listener during playback. In all, there were 12 selections of familiar musical works, including "Edelweiss," Franz Schubert's "Ave Maria," "Auld Lang Syne" and Ludwig van Beethoven's "Ode to Joy." The brain activities of 16 listeners were compared with that of a single violinist.

All the musical pieces resulted in synchronization of brain activity between the musician and the listener, but this was especially true of the more popular performances. Interbrain coherence was insignificant during the early part of each piece and greatest toward its end. The authors explained that the listener required time to initially understand the musical pattern and was later able to enjoy the performance because it matched that person's expectations.

In the left hemisphere of the brain, synchronous activity was localized to an area known as the temporal-parietal junction. This area is important for empathy, the understanding of others' thoughts and intentions, and verbal working memory used for expressing thought. It may function in the retrieval of sounds and patterns that give rise to musical expectations.

But it is the right brain hemisphere that is most often associated with interpretation of musical melody—in contrast to the left hemisphere, which is specialized for the interpretation of speech. In the right hemisphere, synchronization was localized to areas involved in recognizing musical structure and pattern (the inferior frontal cortex) and interpersonal understanding (the inferior frontal and postcentral cortices). These sites also involve "mirror neurons," brain cells that are thought to enable a mirroring or internalization of others' thoughts and actions.

Because music is a group endeavor, it is often used as the context to study coordinated brain function.

Mirror neurons both control movement and respond to the sight of it, giving rise to the notion that their activity during passive observation is a silent rehearsal for when they become engaged in active movement. They were once thought to be a biological substrate for mimicry and, more important, empathy—the source of our understanding of the actions and intentions of others. Mirror neurons have been faddishly implicated in everything from autism to substance use. Nevertheless, nerves that control movement are generally involved in perception as well. And this arrangement is especially true of music, in which physical movement emphasizes melodic gesture or follows a rhythmic beat. Indeed, the auditory cortex enlists other regions of the brain that control movement, showing an innate connection between movement and our understanding of music. No wonder you and your fellow concertgoers dance and move to the music. It is your way of comprehending the music and participating in the encounter.

Because music is a group endeavor, it is often used as a context to study coordinated brain function. Synchronized brain responses among music listeners have been measured by functional magnetic resonance imaging (fMRI) in some studies, whereas other researchers have examined the coordinated actions of performers by tracking the electrical activities of their brains using electroencephalography. Rather than examining the relationships among groups of performers or groups of listeners, the new *NeuroImage* study examined the relationship between an audience and a performer. And it not only followed the degree of concordance in brain activity among these individuals during a musical encounter but also examined how that concordance was related to musical enjoyment. The

brain activity of that person playing air guitar at your concert is closer to that of a true performer than you might have realized.

The various methods used in exploring these relationships have their advantages and shortcomings. For example, the new paper used a technique called functional near-infrared spectroscopy (fNIRS)—which measures the flow of oxygen-rich blood—and it cannot penetrate the brain to investigate deeper structures as well as fMRI does. The major advantage of fNIRS is that no large, expensive instrument is needed, so subjects are comparatively unconstrained when they are tested; it would have been impossible for a violinist to play in an MRI machine.

It is remarkable that the observed degree of synchronization between performer and audience was connected to enjoyment of the music. Such pleasure could provide a powerful means by which music promotes positive social behavior. The pleasantness of music has been attributed to synchronization of electrical activity in the right hemisphere of the brain. Music commands greater attention when it is pleasant, which could contribute to one's feeling of being swept away when listening to a favorite piece. Whereas the authors of the *NeuroImage* paper suggest that the audience's enjoyment was linked to the music's matching of pattern expectations, other studies have shown that surprise is associated with the greatest degree of musical pleasure. Remarkably, even sad music can bring great enjoyment. For example, Mimì's illness and death in the opera *La Bohème* are filled with tragic sadness, endless regrets and lost opportunities for redemption, but the music ultimately leads the audience to a bittersweet sense of transcendence.

Whether encountered by a sole listener of a recorded artist or by part of a packed audience before a full orchestra, music is a shared experience that integrates our intellect, emotions and physical movements. We tap to the beat together and sway in unison to a melody. The experience challenges our cognition to recognize patterns and excites us with pleasure when it surprises us. And we can even enjoy its expression of sadness. Music unites these processes within us and among and between audiences and performers.

—Robert Martone

Americans Increase LSD Use—and a Bleak Outlook for the World May Be to Blame

Millennials and older adults lead the surge while Gen Z stays on the sidelines

In the years leading up to the roaring 2020s, young people were once again dropping acid. Onetime Harvard University psychologist Timothy Leary died almost 25 years ago, after which some of his ashes were launched into space. But from 2015 to 2018, the rate of "turning on and tuning in" with LSD, to paraphrase Leary, increased by more than 50 percent in the U.S.—a rise perhaps fueled by a need for chemical escapism. Those results were published in the July issue of *Drug and Alcohol Dependence*. The authors of the study suspect that many users may be self-medicating with the illegal substance to find relief from depression, anxiety and general stress over the state of the world.

"LSD is used primarily to escape. And given that the world's on fire, people might be using it as a therapeutic mechanism," says Andrew Yockey, a doctoral candidate in health education at the University of Cincinnati and lead author of the paper. "Now that COVID's hit, I'd guess that use has probably tripled."

To arrive at their findings, Yockey and his colleagues turned to data collected from more than 168,000 U.S. adults by the National Survey on Drug Use and Health, an annual, nationally representative questionnaire. They analyzed trends since 2015, partly because of the timing of the 2016 presidential election.

The researchers found that past-year LSD use increased by 56 percent over three years. The rise was especially pronounced in certain user groups, including people with college degrees (who saw a 70 percent increase) and people aged 26 to 34 (59 percent), 35 to 49 (223 percent) and 50 or older (45 percent). Younger people aged 18 to 25, in contrast, decreased their use by 24 percent.

A 1960s-level drug-fueled counterculture revolution probably will not be sweeping the nation anytime soon;

LSD blotter paper

ALAMY

the number of Americans using LSD in a given year still remains less than 1 percent of the total adult population. "LSD is a lot less popular today than it was in the late 1960s and 1970s," says Joseph Palamar, a drug researcher at N.Y.U. Langone Health, who was not involved in the new study. In the late 1970s, for example, Palamar says, 10 percent of high school seniors reported ever using LSD, compared with 6 percent today.

Palamar says the drop in use over that longer period was not necessarily driven by declining interest in psychedelics. Rather it likely occurred because there are other drugs available, such as the psychedelic 2C-B, that have displaced LSD. "However, LSD is perhaps the most popular psychedelic of all time, and it's never going away," he adds.

Similar to users of psilocybin (the active compound in magic mushrooms), recreational LSD users may turn to the drug not only to escape but also "to understand the full capacity of their minds and to improve their well-being," says David Nutt, a neuropsychopharmacologist at Imperial College London, who was not involved in the new study. LSD is often easier to acquire than psilocybin, though—and it is also easier to carry around than a bag of dried mushrooms, he notes.

The U.S. National Survey on Drug Use and Health does not ask users why they took LSD or how large of a dose they consumed. Nutt suspects that the rising popularity of microdosing could explain the overall increase in LSD use. Microdosing involves taking amounts ranging from less than one tenth to half of a "trip" dose of a psychedelic drug—usually in an attempt to sharpen the mind, increase creativity or reduce symptoms of depression and anxiety.

Palamar, however, hypothesizes that an uptick in LSD use is more likely to be related to growing participation in the dance festival scene. In a study published in April, he and his co-author found that past-year LSD use increased from 10 to 17 percent among attendees of electronic dance music parties in New York City between 2016 and 2019.

Yockey points out that the increase in LSD use does not have to be attributed to either microdosing or partying alone; both could be playing a role. Maybe "people are going to a Phish concert" and taking a full dose of LSD, "or they're going to work" and microdosing, he says. And some may also be encouraged to use the drug after reading about studies exploring the therapeutic use of psychedelic substances. Most of this research centers on shorter-acting psilocybin, which is in current or planned clinical trials for treating depression; anxiety; anorexia; obsessive-compulsive dis order; certain severe headaches; and addiction to nicotine, cocaine and alcohol. Studies involving LSD are more limited, not because the substance lacks potential as a therapeutic agent, Nutt says, but because research on it is "virtually impossible" in most countries. In turn, the drug appears to carry more stigma as a result of there being less research associated with its therapeutic use.

The U.S. Drug Enforcement Administration classifies LSD as a Schedule I drug, or one defined as having a serious risk of abuse and no accepted medical value. Significant research shows that the substance is not physically addictive, however, and that LSD overdoses are generally not considered life-threatening and subside within 72 hours. In some cases, people who accidentally overdose on the drug have even reported long-term improvements, according to a study published in the

Journal of Studies on Alcohol and Drugs. In 2015, for example, a 46-year-old woman reportedly took 550 times the normal recreational dose of LSD because she mistook it for a line of cocaine. According to CNN, after being incapacitated for about a day, the woman said that chronic pain she had suffered in her feet and ankles, caused by Lyme disease, had significantly improved. "It just shows that LSD is not that harmful drug that everyone makes it out to be," Yockey says. Of course, there are well-publicized exceptions: for example, the drug can worsen symptoms of schizophrenia and other psychotic disorders.

Although only a handful of studies have been conducted on LSD's effects and therapeutic potential, many of their findings are encouraging. A 2014 paper concluded that LSD administered in a medical setting is safe and can bring lasting benefits. Meanwhile a 2015 study noted that the drug enhanced the emotion evoked by listening to music—an effect the authors believed could be useful for psychedelic-assisted therapy. And a 2017 paper found that LSD, when taken in a controlled setting, increased sociability, trust and feelings of openness. The authors also reported that it reduced anxiety for two months in patients with life-threatening diseases and did not cause complications in a medical context. Similar to findings for psilocybin, other evidence indicates that LSD could be used to alleviate depression and anxiety, treat alcohol dependence and reduce symptoms of autism.

"LSD might be a panacea to anxiety and other psychological disorders," Yockey says. "But as a Schedule I drug, there's just so much red tape behind that that some researchers I've talked to who want to do LSD research say it's not even worth it."

Yockey calls for the depoliticization of LSD, which would make studies of its therapeutic potential and of its effects on recreational users possible. At the same time, he says, efforts to reduce drug use should focus on more harmful substances such as methamphetamine, cocaine and fentanyl—all of which also seem to be on the rise. "These drugs can kill you; LSD cannot," Yockey says. "We need to rectify our messaging."

—Rachel Nuwer

The Brain Interprets Smell Like the Notes of a Song

The sequence in which clusters of olfactory neurons switch on can evoke the smell of an apple instead of a pear

How do humans and other animals distinguish between the smell of rotting seafood and the enticing allure of a ripe banana? New work by researchers at New York University Langone Health and their colleagues uses artificially created odors to help reveal the intricate chain of events that allows one odor to be distinguished from another. The results were published in *Science* in June.

In the deep recesses of the nose are millions of sensory neurons that, along with our eyes and ears, help conjure the world around us. When stimulated by a chemical with a smell, or an odorant, they send nerve impulses to thousands of clusters of neurons in the glomeruli, which make up the olfactory bulb, the brain's smell center. Different patterns of glomerular activation are known to generate the sensation of specific odors. Firing one set of glomeruli elicits the perception of pineapples; firing another evokes pickles.

Unlike other sensations, such as sight and hearing, scientists do not know which qualities of a particular smell the brain uses to perceive it. When you see a person's face, you may remember the eyes, which help you recognize that individual in the future. But the ears and nose might be less important in how the brain represents that person. The authors of the new study sought to identify distinguishing features involved in forming the representation of odors in the brain.

To do so, they used a technique called optogenetics to activate glomeruli in mice. Optogenetics uses light to stimulate specific neurons in the brain, and it can help determine the function of particular brain regions.

By activating certain patterns of activity in glomeruli, the researchers generated "synthetic smells" that the mice perceived as real. They first trained the rodents to recognize the switching on of six specific glomeruli, causing them to perceive an odor that was unknown to the researchers.

The mice received a water reward when they recognized the correct smell. When other glomeruli were activated—generating a different odor—there was no reward.

The study authors then altered the timing and mix of activated glomeruli and observed how doing so affected the mice's behavior. This step allowed them to determine how important each glomerulus was to accurate smell recognition. A given glomerulus in effect acts as its own mini sensory organ within the olfactory bulb.

They found that the sequence of glomerular activation was crucial to odor perception. When they changed which glomerulus was activated first, the mice demonstrated a 30 percent drop in the ability to sense the correct odor. When they changed the last one activated, there was only a 5 percent reduction in detection ability.

"We created an artificial activation pattern, or artificial smell, and trained the mice to recognize it," explains the paper's senior author Dmitry Rinberg, a neuroscientist at N.Y.U. Langone. "Then we modified that pattern to see which cues were most important to forming a perception of it. The thing is, we have no idea what the mice are actually smelling—if it's an apple or an orange, if it stinks, if it's pleasant!"

Rinberg likens smell perception to the melody of a song: The notes—in this case representing activated glomeruli—are important. But without the right timing, the song, or the perceptual experience, falls apart. Changing the seventh note of a melody might be unnoticeable. Swapping the first two might result in a new tune altogether. When we smell, it is about not only which glomeruli are activated but also what time sequence they follow.

Harvard University biology professor Venkatesh N. Murthy, who specializes in the neuroscience of olfaction and who was not involved in the study, points out that there is a large body of evidence relating patterns of glomerular activation to smell perception. The uncertainty has been about whether higher brain regions "read" these activation patterns to identify a smell, as well as how important the order of activation is. "Rinberg and his colleagues show that timing matters," he says, "and, further, that the earliest activated neurons are more important for identification of the odor than those neurons that are activated later. In the song analogy, it's as if the first few notes are key to identifying the piece (think Beethoven's Fifth!)."

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Rinberg hopes to carry his research more deeply into the brain to see how other regions of the organ aid in perceiving odors and objects once they receive information from the olfactory bulb. "We're one small step closer to the movie *The Matrix,*" he jokes. The film features a world ceded to intelligent computers that relegate humans to a shared simulated reality created in their brains—similar to the way the researchers devised an artificial odor. "In a sense, we re-created the movie with smell," Rinberg adds.

—Bret Stetka

Unraveling the Mindset of Victimhood

Focusing on grievances can be debilitating; social science points to a better way

By Scott Barry Kaufman

GETTY IMAGES

Scott Barry Kaufman is a psychologist at Columbia University exploring intelligence, creativity, personality and well-being. In addition to writing the column Beautiful Minds for *Scientific American,* he hosts the Psychology Podcast and is author or editor of eight books, including *Wired to Create: Unraveling the Mysteries of the Creative Mind* (with Carolyn Gregoire) and *Ungifted: Intelligence Redefined.*

QUICK: Rate how much you agree with each of these items on a scale of 1 ("not me at all") to 5 ("this is so me"):

- It is important to me that people who hurt me acknowledge that an injustice has been done to me.
- I think I am much more conscientious and moral in my relations with other people compared with their treatment of me.
- When people who are close to me feel hurt by my actions, it is very important for me to clarify that justice is on my side.
- It is very hard for me to stop thinking about the injustice others have done to me.

If you scored high (4 or 5) on all of these items, you may have what psychologists have identified as a "tendency for interpersonal victimhood."

SOCIAL AMBIGUITY

Social life is full of ambiguity. Dates don't always respond to your text messages, friends don't always smile back at you when you smile at them, and strangers sometimes have upset looks on their faces. The question is: How do you interpret these situations? Do you take everything personally, or do you consider that it is more likely that your friend is just having a bad day, that your new date is still interested but wants to play it cool, and that the stranger on the street was angry about something and didn't even notice you were there?

Whereas most people tend to overcome socially ambiguous situations with relative ease, regulating their emotions and acknowledging that social ambiguity is an unavoidable part of social life, some people tend to see themselves as perpetual victims. Rahav Gabay and her colleagues define this tendency for interpersonal victimhood as "an ongoing feeling that the self is a victim, which is generalized across many kinds of relationships. As a result, victimization becomes a central part of the individual's identity." Those who have a perpetual victimhood mindset tend to have an "external locus of control"; they believe that one's life is entirely under the control of forces outside one's self, such as fate, luck or the mercy of other people.

Based on clinical observations and research, the scientists found that the tendency for interpersonal victimhood consists of four main dimensions: (a) constantly seeking recognition of one's victimhood, (b) a sense of moral elitism, (c) a lack of empathy for the pain and suffering of others, and (d) frequently ruminating about past victimization.

It is important to point out that the researchers do not equate experiencing trauma and victimization with possessing the victimhood mindset. They point out that a victimhood mindset can develop without severe trauma or victimization. Vice versa, experiencing severe trauma or victimization does not necessarily mean that someone is going to develop a victimhood mindset. Nevertheless, the victimhood mindset and victimization do share certain psychological processes and consequences.

Also, although the studies of the four characteristics of the victimhood mindset they identified were conducted at the individual level (with a sample of Jewish Israelis) and do not necessarily apply to the level of groups, a literature review suggests that there are some striking parallels to the collective level (which I point out below).

With these caveats out of the way, let's go a bit deeper into the main characteristics of the perpetual victimhood mindset.

THE VICTIMHOOD MINDSET

Constantly seeking recognition of one's victimhood. Those who score high on this dimension have a perpetual need to have their suffering acknowledged. In general, this is a normal psychological response to trauma. Experiencing trauma tends to "shatter our assumptions" about the world as a just and moral place. The desire for recognition of one's victimhood is a normal response to trauma and can help reestablish a person's confidence in their perception of the world as a fair and just place to live.

Also, it is normal for victims to want the perpetrators to take responsibility for their wrongdoing and to express feelings of guilt. Studies using testimonies of patients and therapists have found that validation of the trauma is important for therapeutic recovery from that trauma and victimization (see here and here).

A sense of moral elitism. Those who score high on this dimension perceive themselves as having an immaculate

morality and view everyone else as being immoral. People may use moral elitism to control others by accusing them of being immoral, unfair or selfish while seeing themselves as supremely moral and ethical.

Moral elitism often develops as a defense mechanism against deeply painful emotions and as a way to maintain a positive self-image. As a result, those under distress tend to deny their own aggressiveness and destructive impulses and project them onto others. The "other" is perceived as threatening, whereas the self is perceived as persecuted, vulnerable and morally superior.

Although splitting the world into those who are "saints" and those who are "pure evil" may protect one from pain and damage to their self-image, it ultimately stunts growth and development and ignores the ability to see the self and the world in all of its complexity.

A lack of empathy for the pain and suffering of others. People scoring high on this dimension are so preoccupied with their own victimhood that they are oblivious to the pain and suffering of others. Research shows that people who have just been wronged or who are reminded of a time when they were wronged feel entitled to behave aggressively and selfishly, ignoring the suffering of others and taking more for themselves while leaving less to others. Emily Zitek and her colleagues suggest that such individuals may feel as though they have suffered enough, so they no longer feel obligated to care about the pain and suffering of others. As a result, they pass up opportunities to help those perceived as being in an out-group.

At the group level, research suggests that increased attention to an in-group's victimization reduces empathy toward the adversary as well as toward unrelated adversaries. Even just the priming of victimhood has been shown to increase ongoing conflicts, with the priming leading to reduced levels of empathy toward the adversary and to people being more willing to accept less collective guilt for current harm. In fact, research on "competitive victimhood" shows that members of groups involved in violent conflicts tend to see their victimization as exclusive and are likely to minimize, belittle or outright deny their adversary's suffering and pain (see here and here).

A group that is completely preoccupied with its own suffering can develop what psychologists refer to as an "egoism of victimhood," whereby members are unable to see things from the rival group's perspective, are unable or unwilling to empathize with the suffering of the rival group and are unwilling to accept any responsibility for harm inflicted by their own group (see here and here).

Frequently ruminating about past victimization. Those scoring high on this dimension constantly ruminate on and talk about their interpersonal offenses and their causes and consequences rather than thinking about or discussing possible solutions. This may include expected future offenses or past offenses. Research shows that victims tend to ruminate over their interpersonal offenses and that such rumination decreases the motivation for forgiveness by increasing the drive to seek revenge.

At the group level of analysis, victimized groups tend to frequently ruminate over their traumatic events. For instance, the widespread existence of Holocaust material in Jewish Israeli school curricula, cultural products and political discourse has increased over the years. Although modern-day Jewish Israelis are generally not direct victims of the Holocaust, Israelis are increasingly preoccupied with the Holocaust, dwelling on it and fearing that it could happen again.

CONSEQUENCES OF THE MINDSET

In an interpersonal conflict, all parties are motivated to maintain a positive moral self-image. As a result, the different parties are likely to create two very different subjective realities. Offenders tend to downplay the severity of the transgression, whereas victims tend to perceive the offenders' motivations as arbitrary, senseless, immoral and more severe.

Therefore, the mindset one develops—as a victim or as a perpetrator—has a fundamental effect on the way the situation is perceived and remembered. Gabay and her colleagues identified three main cognitive biases that characterize the tendency for interpersonal victimhood: interpretation, attribution and memory biases. All three of these biases contribute to a lack of willingness to forgive others for their perceived transgressions.

Let's dive deeper into these biases.

Interpretation Bias

The first interpretation bias involves the perceived offensiveness of a social situation. The researchers found that people with a higher tendency toward interpersonal victimhood perceived both low-severity offenses (e.g., lack of help) and high-severity offenses (e.g., offensive statements regarding their integrity and personality) as more severe.

The second interpretation bias involves the anticipation of hurt in ambiguous situations. The researchers found that people with a greater tendency toward interpersonal victimhood were more likely to assume that a new manager in their department would show less consideration and willingness to help them even before they actually met.

Attribution of Hurtful Behaviors

Those with a propensity for interpersonal victimhood were also more likely to assume negative intentions on the part of the offender and to feel a greater intensity and duration of negative emotions following a hurtful event.

These findings are consistent with work showing that the extent to which people find an interaction hurtful is related to their perception that the hurtful behavior was intentional. People with a tendency toward interpersonal victimhood may experience offenses more

intensely because they attribute more malicious intent to the offender than those who score lower for interpersonal victimhood.

This bias has been found to exist at the collective level as well. Social psychologist Noa Schori-Eyal and her colleagues found that those who scored higher on a "Perpetual In-group Victimhood Orientation" scale—a measurement of the belief that one's in-group is constantly being victimized and persecuted by different enemies and in different time periods—had a greater tendency to categorize out-groups as hostile to the in-group and responded faster to such categorization (suggesting it was more automatic). Those with high scores on this scale were also more likely to attribute malevolent intentions to out-group members in ambiguous situations, and when primed with reminders of historical group trauma, they were more likely to attribute malevolent intentions to the out-group.

It is also noteworthy that in their study, even though most of their participants were Jewish Israelis, there was still quite a bit of variability in the degree to which people endorsed the perpetual in-group victimhood orientation. This is further evidence that just because someone has been victimized does not mean that they have to view themselves as a victim. The victimhood mindset is not the same as actually experiencing collective and/or interpersonal trauma, and there exist a number of people who experienced the same trauma but refused to perceive themselves as perpetual in-group victims.

Memory Bias

Those with a greater tendency toward interpersonal victimhood also had a greater negative memory bias, recalling more words representing offensive behaviors and feelings of hurt (e.g., "betrayal," "anger," "disappointment") and recalling negative emotions more easily. The inclination for interpersonal victimhood was unrelated to positive interpretations, attributions or the recall of positive emotional words, suggesting that it was specifically the negative stimuli that activated the victimhood mindset. These findings are in line with prior studies finding that rumination facilitates increased negative recall of events and recognition in different psychological situations.

At the group level, groups are likely to endorse and remember events that affected them the most emotionally, including events in which the in-group was victimized by another group.

Forgiveness

The researchers also found that people with a high tendency to demonstrate interpersonal victimhood were less willing to forgive others after an offense, expressed an increased desire for revenge rather than mere avoidance, and were more likely to actually behave in a revengeful manner. The researchers argue that one possible explanation for the low avoidant tendencies may be the higher need for recognition among those scoring high on the tendency for interpersonal victimhood. More important, this effect was mediated by perspective taking, which was negatively correlated with the tendency for interpersonal victimhood.

Similar findings have been found at the group level. A strong sense of collective victimhood is associated with a low willingness to forgive and an increased desire for revenge. This finding has been replicated in diverse contexts, including thinking of the Holocaust, the conflict in Northern Ireland and the Israeli-Palestinian conflict.

A MINDSET'S ORIGINS

Where does the victimhood mindset come from? At an individual level, many different factors most certainly play a role, including real victimization in one's past. The researchers found, however, that an anxious attachment style was a particularly strong antecedent of the tendency for interpersonal victimhood.

Anxiously attached individuals tend to be dependent on the approval and continual validation of others. They seek reassurance continually because of their doubts about their own social value. This leads anxiously attached individuals to see others in a highly ambivalent manner.

On the one hand, anxiously attached individuals anticipate rejection from others. On the other hand, they feel dependent on others to validate their self-esteem and worth. As for the direct link between anxious attachment and the tendency toward interpersonal victimhood, the researchers note that "from a motivational point of view, the tendency for interpersonal victimhood seems to offer anxiously attached individuals an effective framework for constructing their insecure relations with others, which involves garnering their attention, compassion, and evaluation, and at the same time experiencing difficult negative feelings and expressing them within their relationships."

At the group level, Gabay and her colleagues point to the potential role of socialization processes in the development of collective victimhood. They note that victim beliefs, as is the case for any other human belief, can be learned (see here and here). Through many different channels—such as education, television programs and online social media—group members can learn that victimhood can be leveraged as a power play and that aggressiveness can be legitimate and fair if one party has suffered. People may learn that internalizing a victimhood mentality can give them power over others and protect them from any of the consequences of online mobbing and shaming that they may impose on members of the perceived out-group.

FROM VICTIMHOOD TO GROWTH

Truth is, we currently live in a culture where many political and cultural groups and individuals emphasize their victimhood identity and compete in the "Victimhood Olympics." Charles Sykes, author of A Nation of

Victims: The Decay of the American Character, noted that this stems in part from the entitlement of groups and individuals for happiness and fulfillment. Building on Sykes's work, Gabay and her colleagues note: "When these feelings of entitlement are combined with a high individual-level tendency for interpersonal victimhood, social change struggles are more likely to take an aggressive, disparaging, and condescending form."

But there's the thing: If socialization processes can instill in individuals a victimhood mindset, then surely the very same processes can instill in people a personal-growth mindset. What if we all learned at a young age that our traumas do not have to define us? That it is possible to experience a trauma and for victimhood to not form the core of our identity? That it is even possible to grow from trauma, to become a better person, to use the experiences we have had in our lives to work toward instilling hope and a sense of possibility in others who were in a similar situation? What if we all learned that it is possible to have healthy pride in an in-group without having out-group hate? That if you expect kindness from others, it pays to be kind yourself? That no one is entitled to anything but we all are worthy of being treated as human?

This would be quite the paradigm shift, but it would be in line with the latest social science that makes clear that a perpetual victimhood mindset leads us to see the world pessimistically. With a clear view, we would be able to see that not everyone in an out-group is evil and that not everyone in our in-group is a saint. We are all human with the same underlying needs to belong, to be seen, to be heard and to matter.

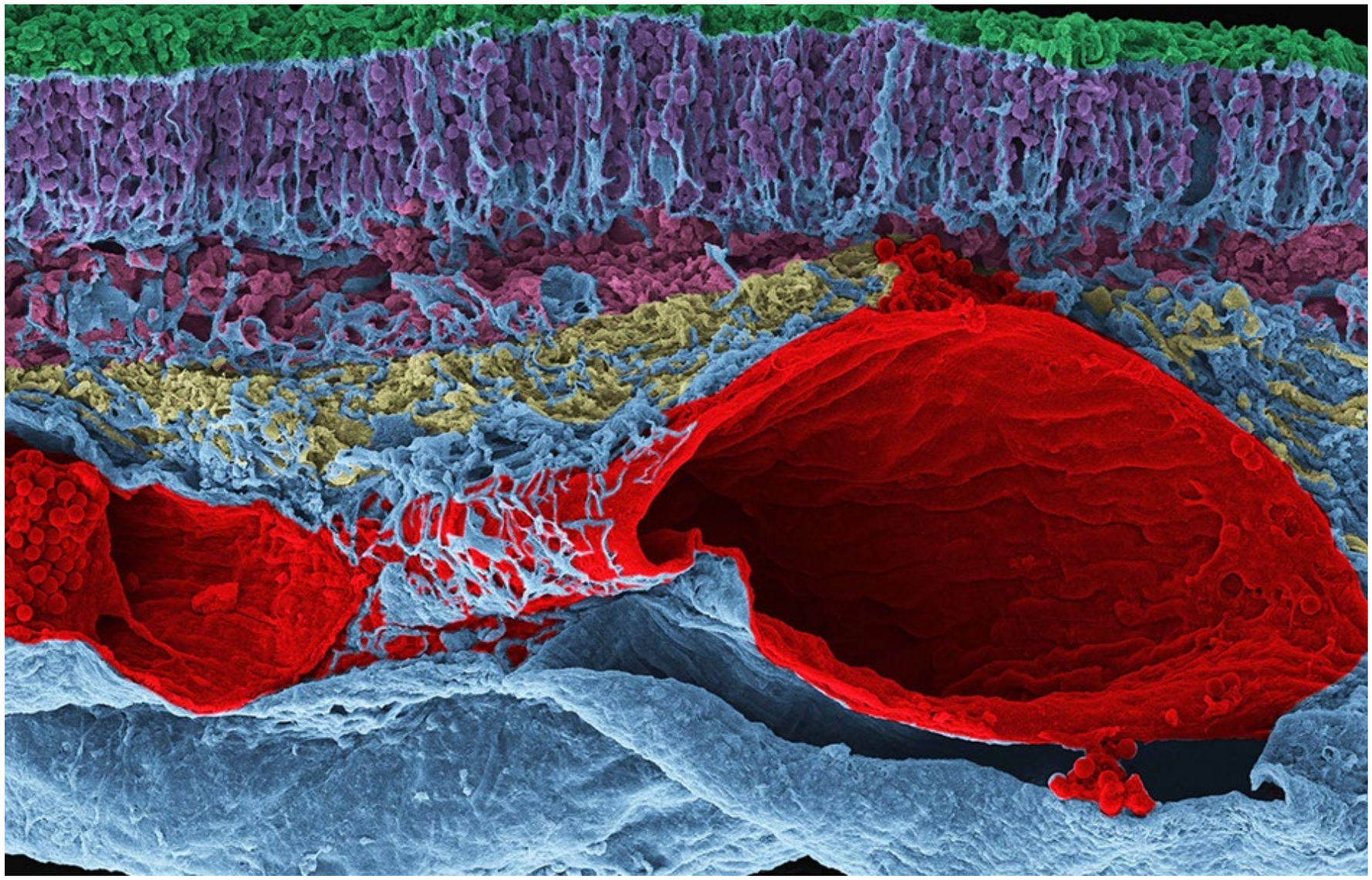
Seeing reality as clearly as possible is essential for making long-lasting change, and I believe one important step along that path is to shed the perpetual victimhood mindset and replace it with something more productive, constructive, hopeful and amenable to building positive relationships with others.

THE ART OF NEUROSCIENCE

The Beautiful Things inside Your Head: Winners of the 10th Annual Art of Neuroscience Contest

By Karen Kwon and Liz Tormes

The top works—and our favorites—range from interactive pieces to a pen-and-paper drawing



WHALE RETINA RAINBOW. ELENA VECINO CORDERO UNIVERSITY OF THE BASQUE COUNTRY AND LUIS LÓPEZ VECINO

IN 1968 AN EXHIBIT ENTITLED "Cybernetic Serendipity: The Computer and the Arts" was held at the Institute of Contemporary Arts in London. The first major event of its kind, "Cybernetic Serendipity" aimed to "present an area of activity which manifests artists' involvement with science, and the scientists' involvement with the arts," wrote British art critic Jasia Reichardt, who curated the exhibit. Even though it was an art show, "most of the participants in the exhibition were scientists," Reichardt said in a 2014 video. "Artists didn't have computers in the 1960s." A lot has changed since then, however. Computers, no longer the commodity of a select few, help artists to deviate from more traditional mediums.

The changes since the 1960s are well reflected in the entries for the 2020 Art of Neuroscience competition, held by the Netherlands Institute for Neuroscience. Now marking its 10th year, the contest features some highly technological pieces and others grounded in classical methods, such as drawing with pen on paper. The winning entries were created by independent artists and by working scientists, demonstrating that art and neuroscience can inspire both professions. A winner and four honorable mentions were selected from dozens of submitted works. And seven pieces were chosen by *Scientific American* as Editor's Picks. Photography editor Liz Tormes served on the panel of judges for the competition.

Karen Kwon is a 2020 AAAS Mass Media Fellow at *Scientific American*. She recently earned her Ph.D. in chemistry at Columbia University.

Liz Tormes is assistant photo editor for *Scientific American*. You can find her on Instagram @dame.liz

THE ART OF NEUROSCIENCE

Winner

31-3594

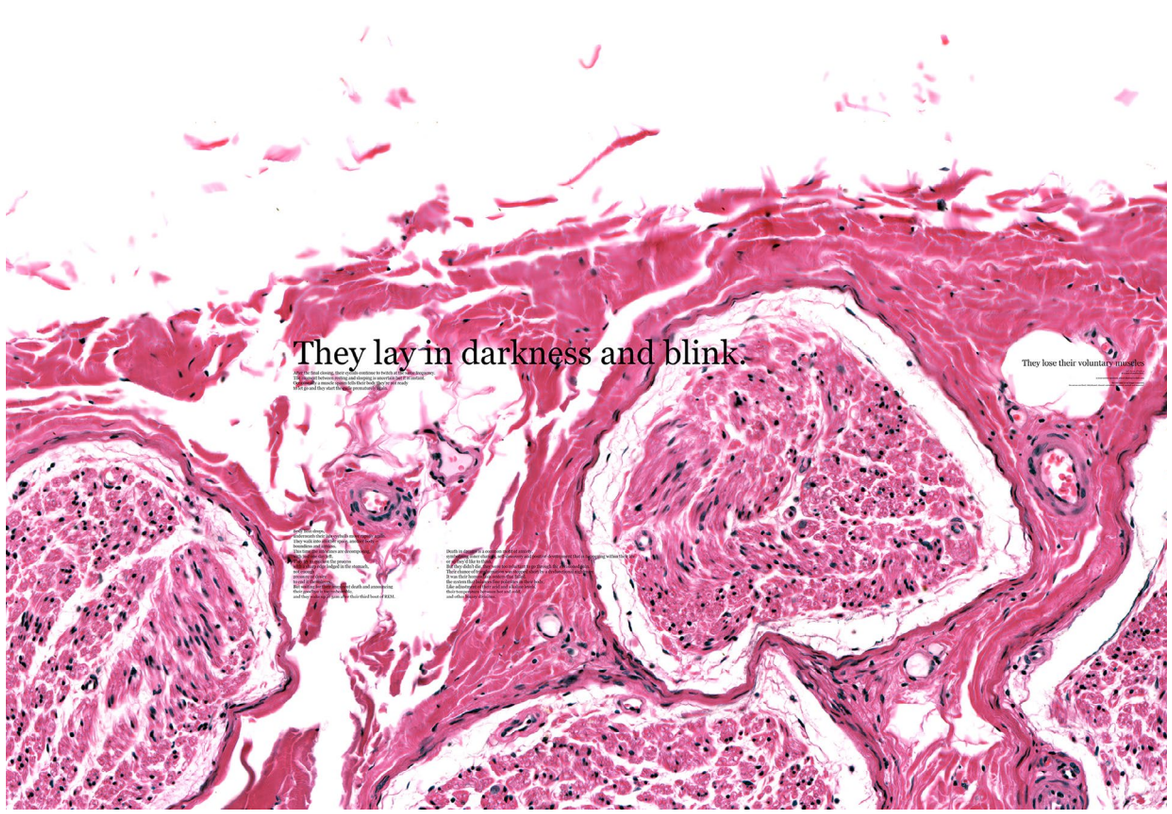
By Lidija Kononenko

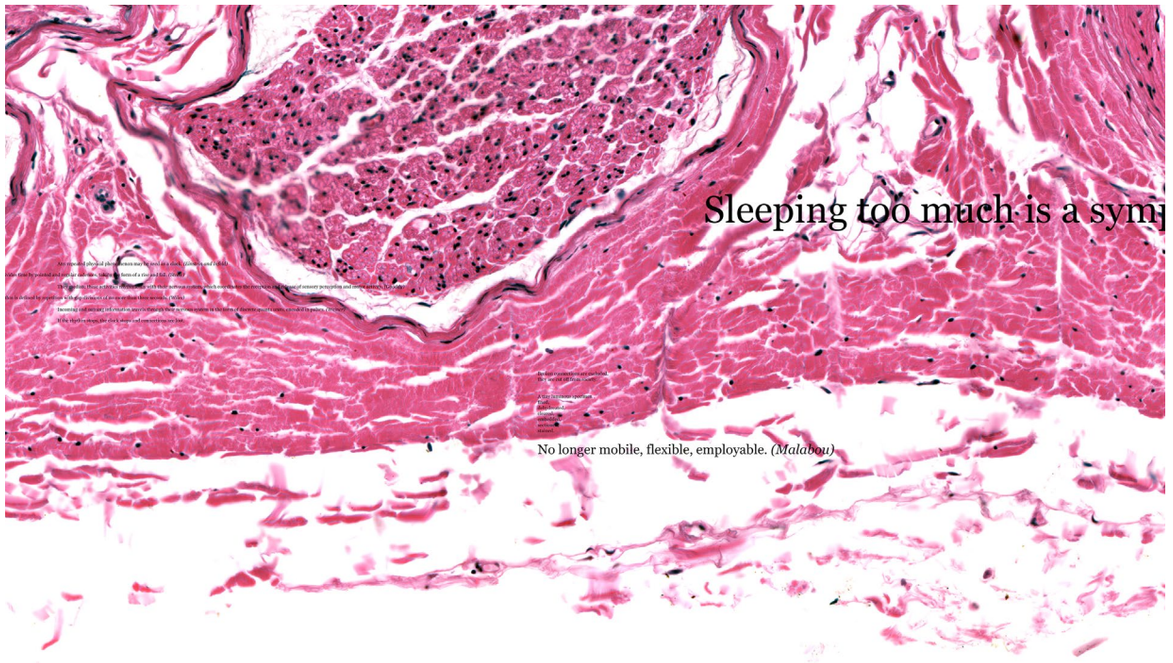
Artist Kononenko described this interactive piece as "a microscope specimen, a map of symptoms, and an investigation of the unknown" in a statement accompanying it. Viewers can zoom in and explore the details of a microscope image of the peripheral nerve system, which is overlaid by textual facts and poetic phrases about sleep.

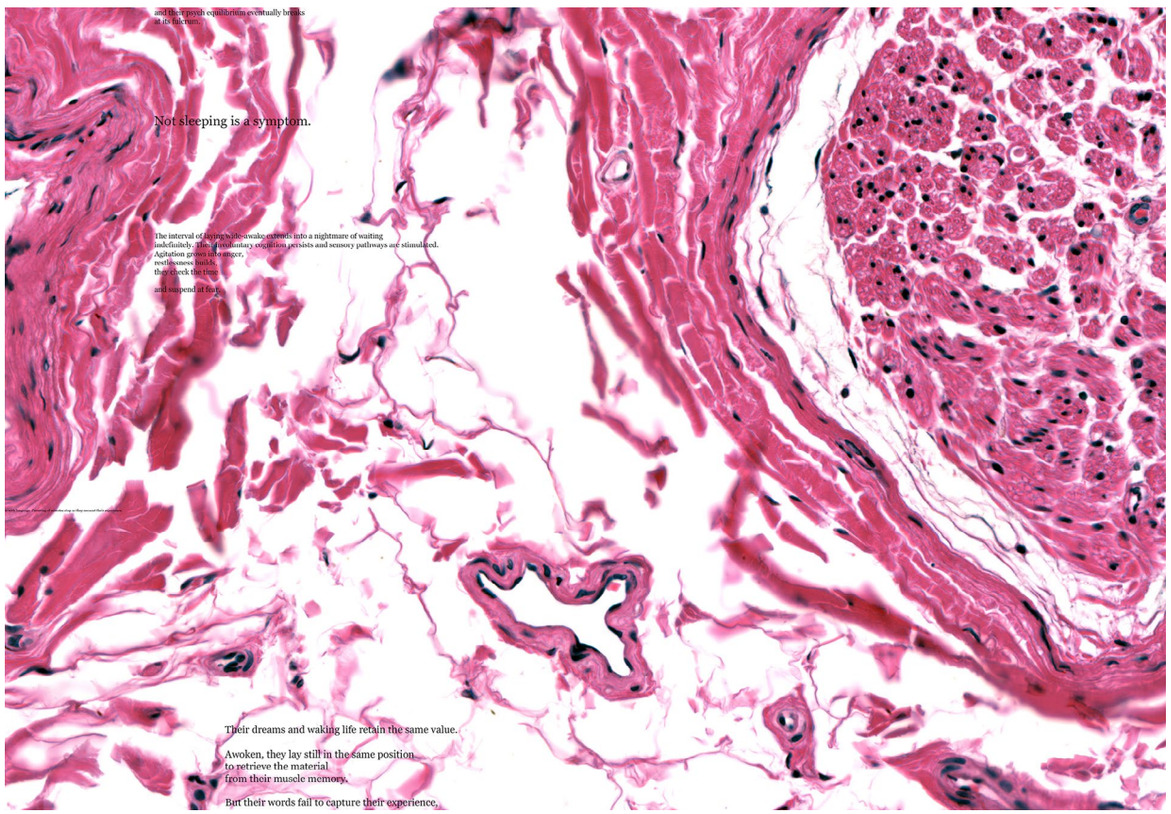
Sleep is "a voluntary act of losing one's own consciousness," Kononenko explained in her statement. The poetic snippets resemble the fragmented thoughts humans have while falling asleep. And zooming in and out of the image represents the transition between wakefulness and sleep. Additionally, *31-3594* allows the viewer to act as a pathologist, achieving the goal of blending neuroscience and art. In assessing this unique piece, the jurors praised it for "the interactivity and playful combination of imagery of a human peripheral nerve with a text-based story that unfolds at various scales and highlights the role of the nervous system in the human condition."

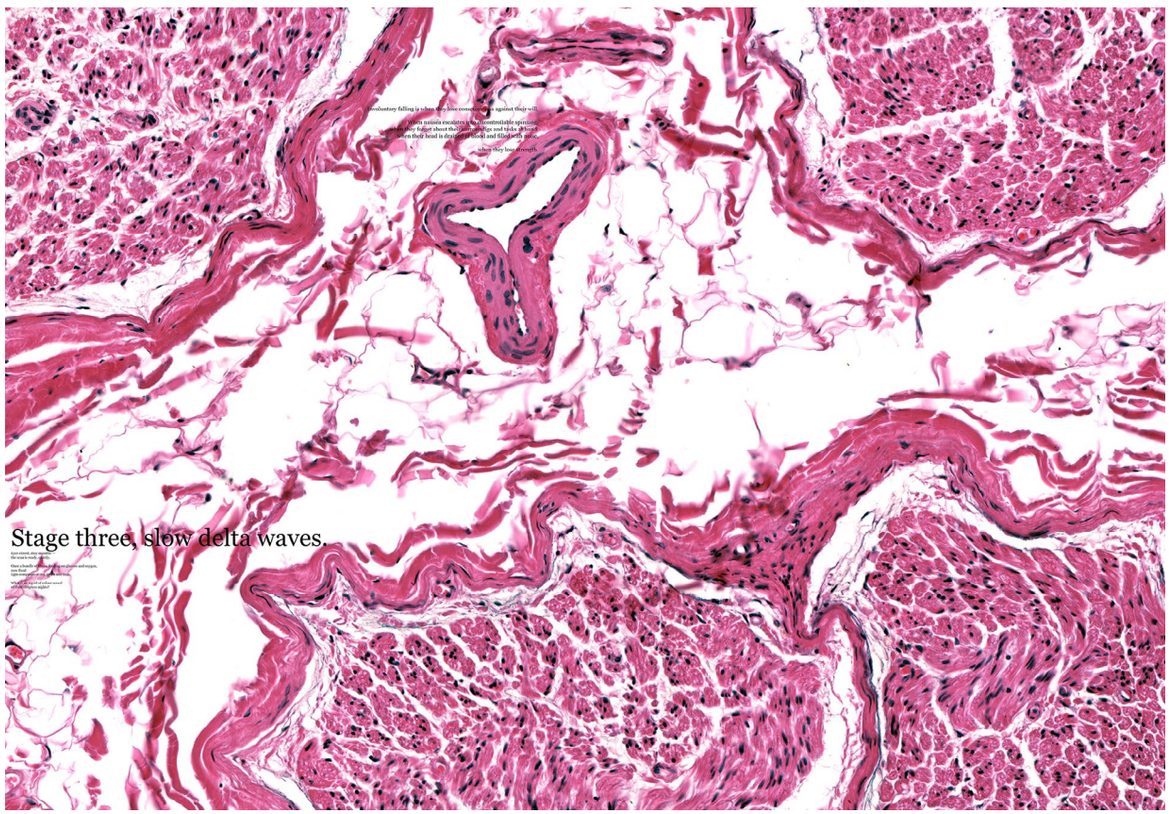
LIDIJA KONONENKO; SUPPORTED BY LIGHT MICROSCOPY CORE FACILITY, UNIVERSITY COLLEGE LONDON GREAT ORMOND STREET INSTITUTE OF CHILD HEALTH

Winner *continued*









LIDIJA KONONENKO; SUPPORTED BY LIGHT MICROSCOPY CORE FACILITY, UNIVERSITY COLLEGE LONDON GREAT ORMOND STREET INSTITUTE OF CHILD HEALTH

Honorable Mention

Red Haze

By Nicki Coveña

A tsunami of red dots dominates this image by neuroscientist Coveña. The bright-red color comes from a fluorescent protein that was used to visualize the workings of *TBR1*—a gene that synthesizes the protein that regulates the information transfer from DNA to messenger RNA in vertebrate embryo development. “The out-of-focus view makes one guess at what details are hidden below,” the jurors wrote.

NICKI COVEÑA

THE ART OF NEUROSCIENCE

Honorable Mention

Bdl

By Paméla Simard

Artist Simard partnered with Hunter Shaw, a neuroscientist then at McGill University, to create a series of delicate wood sculptures. "The various installations were created from fluorescent microscopy images representing the visual system of the fruit fly brain," Simard wrote in her statement. They reproduced the intricate details of the fruit fly's visual system by first laminating thin slices of different types of wood together, then hand-cutting the result to mimic the microscope images.

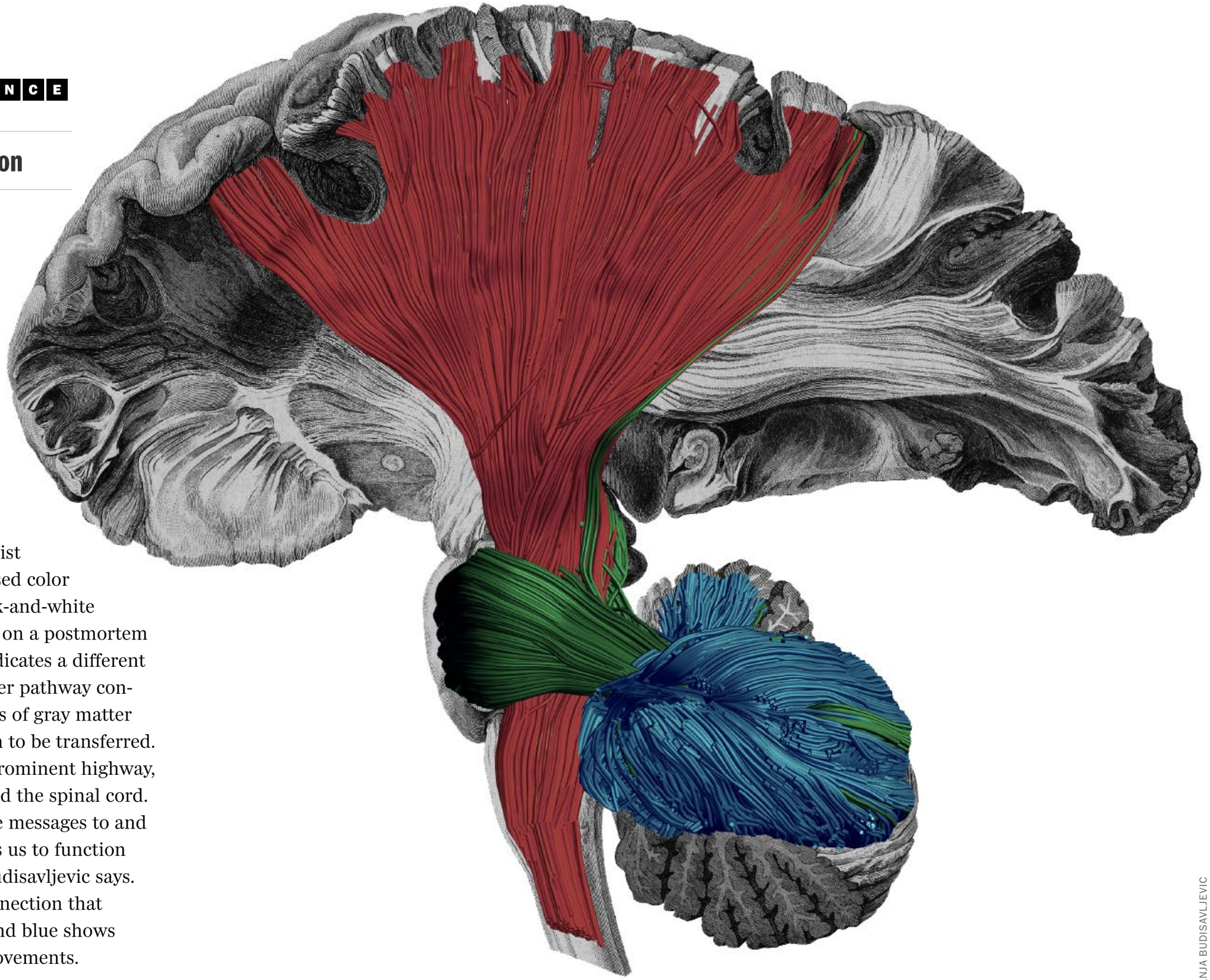
PAMÉLA SIMARD (*ARTWORK*); ALEX TRAN (*PHOTOGRAPHS*)

THE ART OF NEUROSCIENCE

Honorable Mention

Motor White Matter Networks of the Human Brain

By Sanja Budisavljevic



In this piece, neuroscientist Budisavljevic superimposed color onto a 19th-century black-and-white drawing of a brain based on a postmortem dissection. Each color indicates a different "highway," or white matter pathway connecting particular regions of gray matter and allowing information to be transferred. Red indicates the most prominent highway, which links the cortex and the spinal cord. "This pathway carries the messages to and from the body and allows us to function in our sensory world," Budisavljevic says. Green represents the connection that supports coordination, and blue shows the one that regulates movements.

SANJA BUDISAVLJEVIC

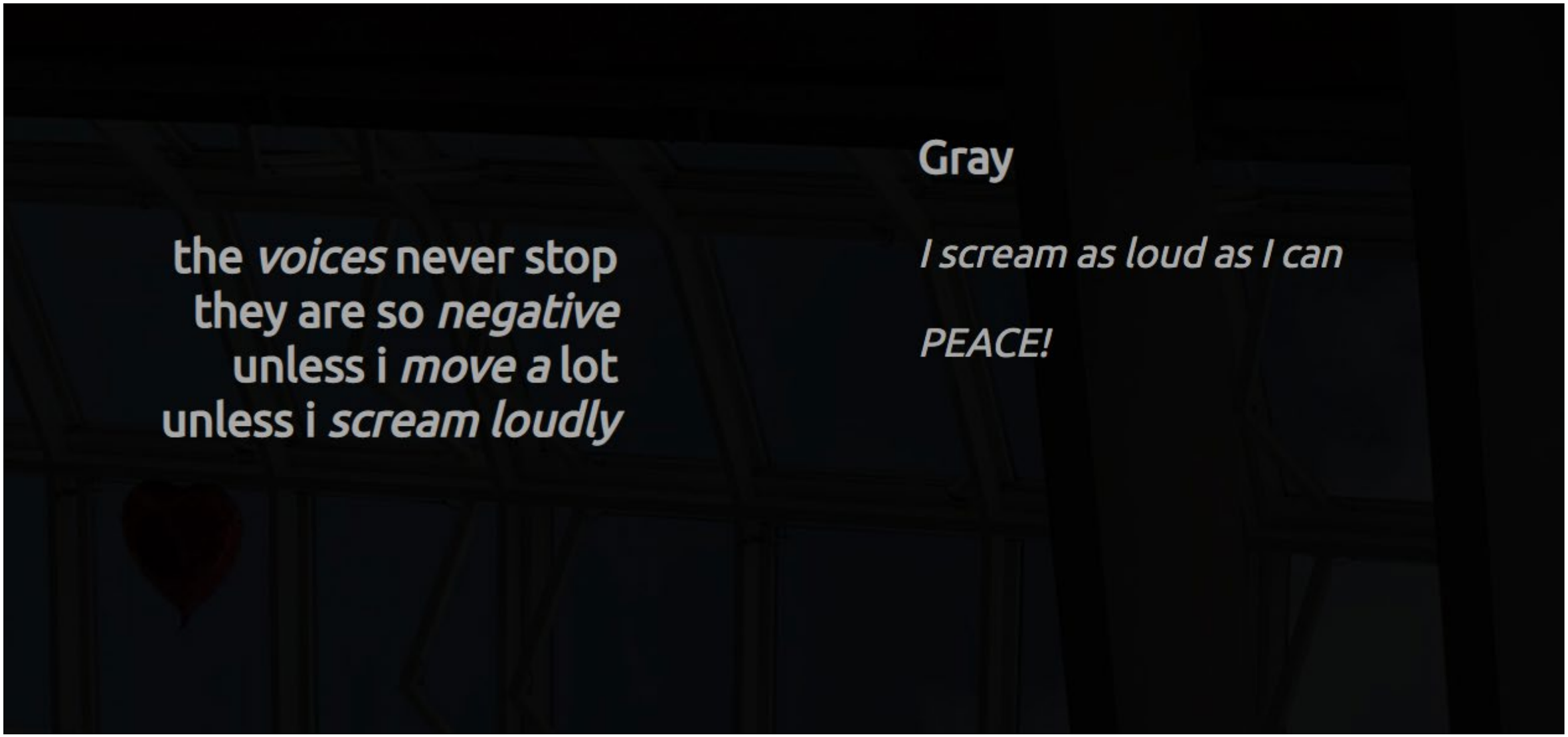
THE ART OF NEUROSCIENCE

Honorable Mention

Psychoetry

By Frank Gerritse and Janna de Boer

This interactive piece, created by psychiatrists Gerritse and de Boer, allows viewers to experience auditory verbal hallucinations—voices that appear in one's head. "People who hear voices often feel trapped and experience little or no control," Gerritse and de Boer wrote in a brochure about the project. Singing, screaming, or getting up and moving around, however, help some of them to perceive the voices as less negative. The researchers programmed their piece to emulate this experience, as well as to allow "people to influence both the amount and the content of the hallucinations," they wrote. When the interactive launches, users face disparaging text that simulates negative self-talk; this material was recorded and transcribed from real hallucinations. They can also hear loud noises by clicking on a headphone icon. To make the text display stop for a few seconds, viewers can yell at their computer after enabling its microphone access. Similarly, when they jiggle their mouse or quickly move their fingers across their trackpad—imitating the real-life movements that help disrupt hallucinations—the text becomes "nicer" and less critical. Editor's Note: *Viewer discretion is advised because some of the text includes obscene language. The Web site works best with Chrome, and the browser's auto-translate function is recommended for non-Dutch speakers.*



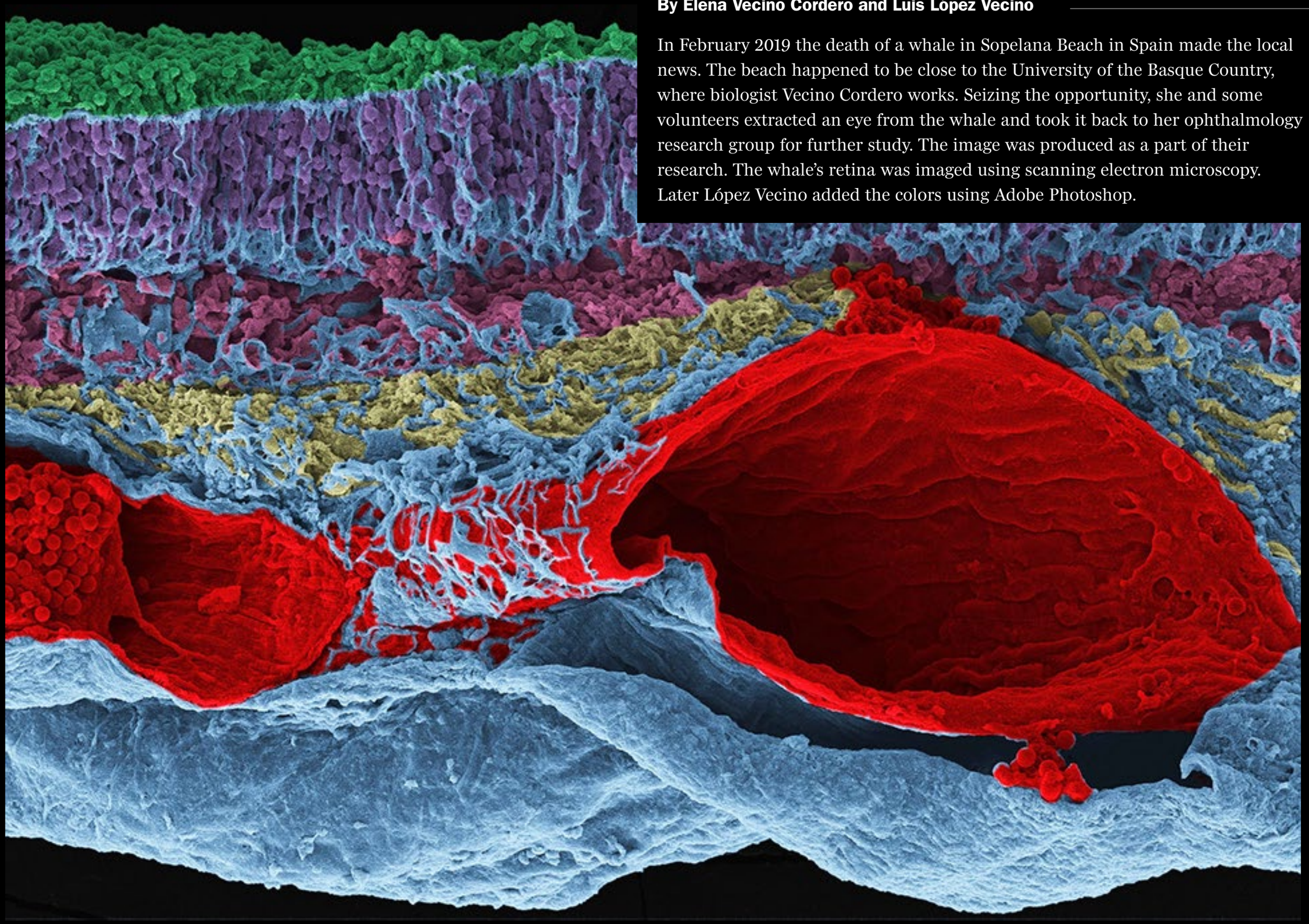
FRANK GERRITSE AND JANNA DE BOER

Whale Retina Rainbow

By Elena Vecino Cordero and Luis López Vecino

Editor's Pick

In February 2019 the death of a whale in Sopelana Beach in Spain made the local news. The beach happened to be close to the University of the Basque Country, where biologist Vecino Cordero works. Seizing the opportunity, she and some volunteers extracted an eye from the whale and took it back to her ophthalmology research group for further study. The image was produced as a part of their research. The whale's retina was imaged using scanning electron microscopy. Later López Vecino added the colors using Adobe Photoshop.



ELENA VECINO CORDERO UNIVERSITY OF THE BASQUE COUNTRY AND LUIS LÓPEZ VECINO

THE ART OF NEUROSCIENCE

Editor's Pick

Shelter in Place

By Geinene Carson

As its title suggests, this piece represents "the artist's interpretation of the pandemic experience" while sheltering in place because of COVID-19, according to artist Carson's statement. This acrylic-on-canvas piece is a part of a series titled *Neuron,* which started as "visual prayers for our daughter with a rare genetic disorder," Carson wrote on her Web site. Although "shelter in place" implies physical restrictions, Carson, who is based in Atlanta, draws inspiration from the neural network "because as important as our physical surroundings are to our state of living, our thought life holds the key to thriving within whatever the circumstances may be," she wrote.

GEINENE CARSON

THE ART OF NEUROSCIENCE

Editor's Pick

Memories and Patterns: Oligodendrocytes

By Shanthi Chandrasekar

Oligodendrocytes are glial cells that support and insulate long neuronal axons. The cells' lipid membrane wraps around the axons to strengthen the structure, as well as to help neurons send signals quickly. "A single oligodendrocyte can connect with multiple axons," artist Chandrasekar wrote in her statement. "In this [pen-and-ink] drawing, I have tried to bring out the connectedness of the oligodendrocytes and the axons."

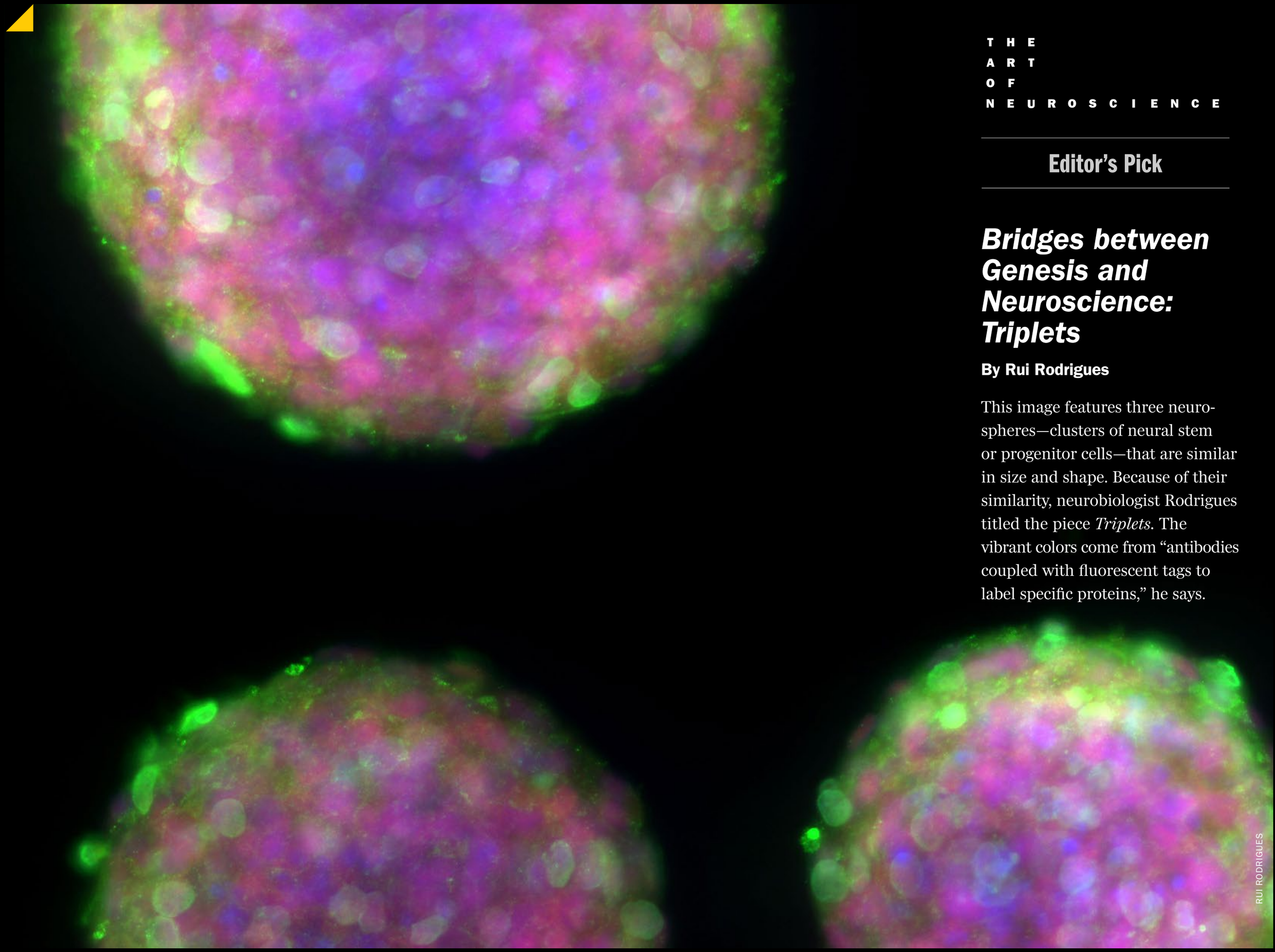
SHANTHI CHANDRASEKAR; THE MEMORIES AND PATTERNS SERIES IS SUPPORTED, IN PART, BY FUNDING FROM THE MONTGOMERY COUNTY GOVERNMENT AND THE ARTS AND HUMANITIES COUNCIL OF MONTGOMERY COUNTY, MARYLAND

Editor's Pick

Bridges between Genesis and Neuroscience: Triplets

By Rui Rodrigues

This image features three neurospheres—clusters of neural stem or progenitor cells—that are similar in size and shape. Because of their similarity, neurobiologist Rodrigues titled the piece *Triplets*. The vibrant colors come from "antibodies coupled with fluorescent tags to label specific proteins," he says.



RUI RODRIGUES

THE ART OF NEUROSCIENCE

Editor's Pick

Fading Engram

By Alexandra Leighton

"Our experience of the world and our sense of self are shaped by what we remember," neuroscientist Leighton wrote in her statement. "Some memories stay crystal clear, others become distorted or slip away as time passes by." Well-defined and blurred peaks represent sharp and faded memories. This piece—made with acrylic and gold leaf on canvas—was inspired by images of hippocampal neurons, which are known to play a significant role in memory formation.

ALEXANDRA HELEN LEIGHTON

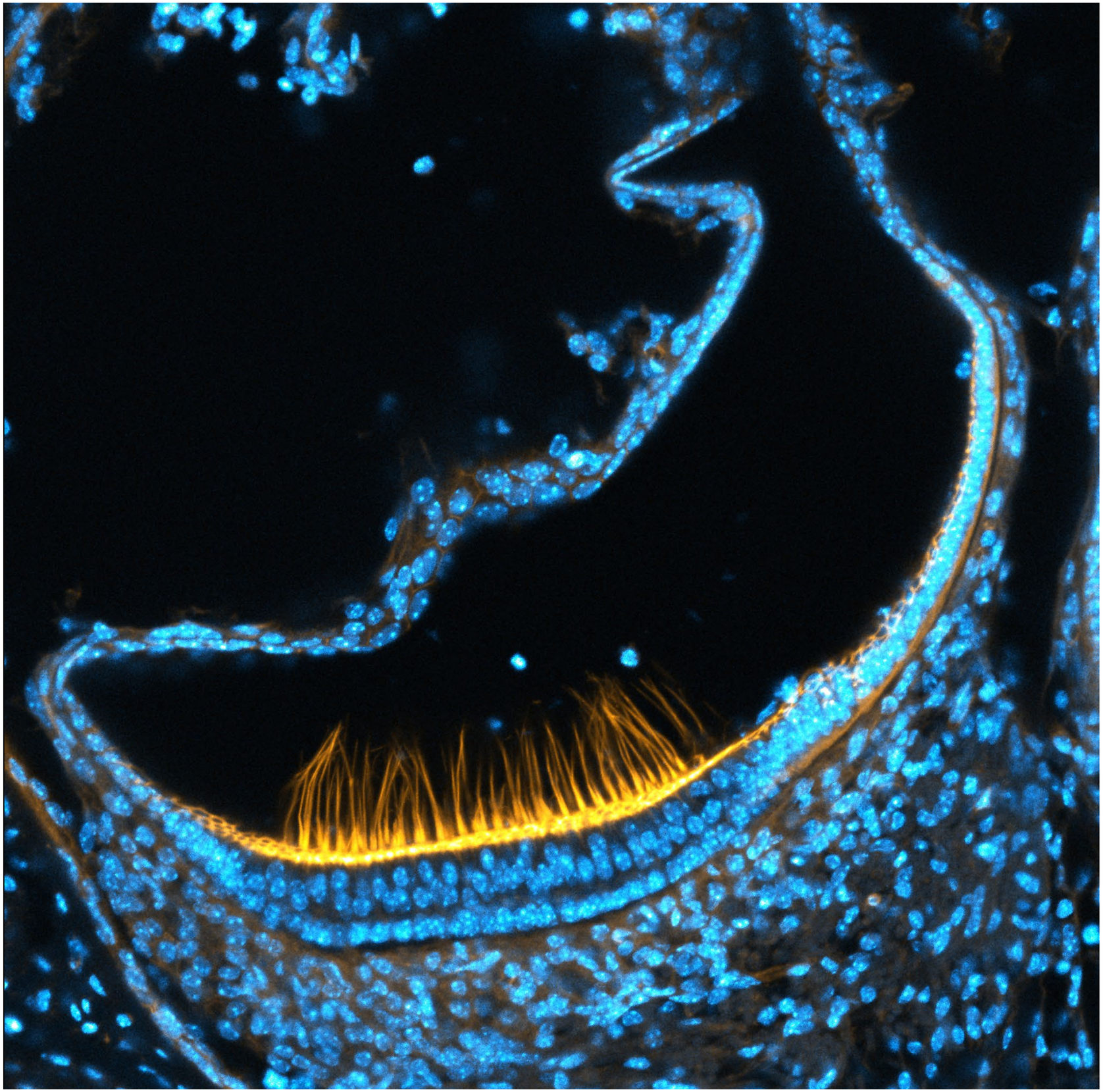
THE ART OF NEUROSCIENCE

Editor's Pick

Sensing Spin

By Dan Jagger

Physiologist Jagger used a high-resolution microscope to capture this image. It shows mechanosensory hair cells located in the inner ear that play a role in the sense of balance. A protein called actin is within bundles of stereocilia and is stained yellow. Actin helps the bundles to stand upright, so when the human head turns, they can detect the movement of the fluid they are immersed in. The hair-cell nuclei are stained with cyan.



DAN JAGGER UCL EAR INSTITUTE, UNIVERSITY COLLEGE LONDON

THE ART OF NEUROSCIENCE

Editor's Pick

The Protection of Nature Starts in Our Mind

By Robert Luck

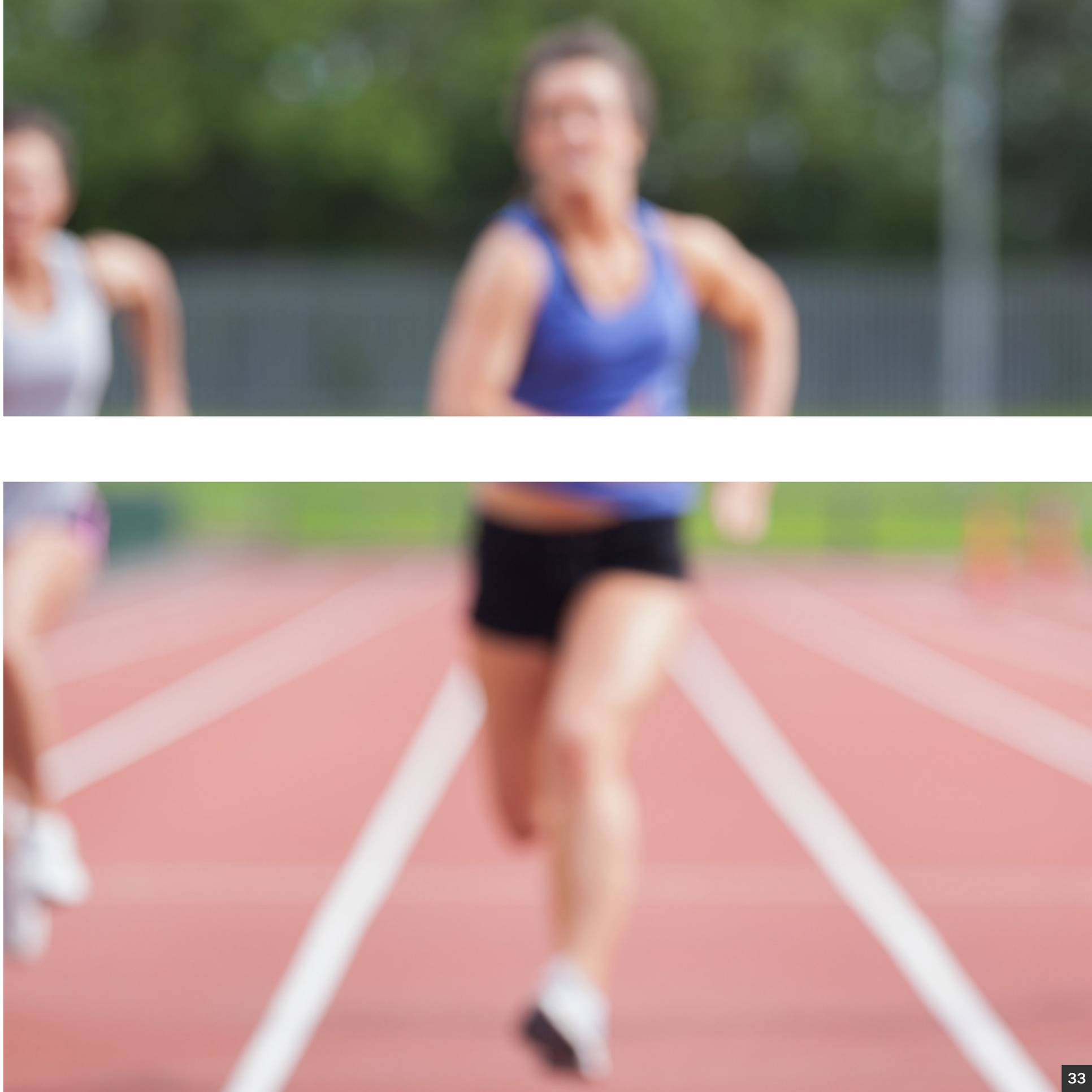
Luck is a neuroscientist at Heidelberg University in Germany who studies the development of the cerebellum, located where the spinal cord meets the brain. Alarmed by climate change and deforestation, he created a "mind forest" that resembles bird's-eye-view photographs of real forests. The "trees" are 65 individually traced images of mice's Purkinje neurons, which play important roles in controlling coordination and movements. "I chose the number 65 to represent the number of years needed for the rainforest to regrow and gain back at least 80 percent of its diversity," Luck wrote in his statement. "[Sixty-five] years—a human lifetime!"

ROBERT LUCK EUROPEAN CENTER FOR ANGIOSCIENCE, MEDICAL FACULTY MANNHEIM, HEIDELBERG UNIVERSITY

Why Feeling Close to the Finish Line Makes You Push Harder

Behavioral scientist Oleg Urminsky explains why you work harder when you get close to achieving a goal

By Katy Milkman and Kassie Brabaw



Katy Milkman is a behavioral scientist and professor of operations, information and decisions at the Wharton School at the University of Pennsylvania. She is also president of the Society for Judgment and Decision Making, host of the podcast Choiceology and co-director of the Behavior Change for Good Initiative. **Kassie Brabaw** is a journalist writing about health, relationships and astronomy. Find her work at *Health,* SELF.com, *Women's Health,* VICE.com and Space.com.

EVERYONE HAS GOALS they are striving to achieve, even during a global pandemic. Maybe you are a scientist working around the clock to find a cure for COVID-19 (if so, thank you and good luck!). Or maybe you are stuck working from home and pushing hard to hit 10,000 steps a day while confined to a small, urban living space. Whatever it is you are striving to achieve, science shows that you are likely to push harder the closer you feel to the finish line. When researchers first speculated about this tendency, they called it the goal-gradient hypothesis. And it turns out to have interesting implications not only for predicting when we will push ourselves the hardest but also for marketers hoping to convince us to buy our next cup of coffee or take our next airline flight (at least, once we start flying again).

Oleg Urminsky, a professor of marketing at the University of Chicago Booth School of Business, has been studying the goal-gradient hypothesis since he was a doctoral student. Recently Katy Milkman, a professor at the Wharton School of the University of Pennsylvania, got to chat with Urminsky in an interview for the podcast Choiceology.

[*An edited transcript of the interview follows.*]

Can you explain what the goal-gradient hypothesis is?

The basic idea is that the closer we get to completing a goal, the more motivated we are to continue working on it and achieve that goal.

Can you explain how your classic 2006 paper demonstrated this?

There were some early studies that tried to test this in a couple of ways. Two of my favorites: in one, some researchers designed an apparatus they would attach cigarettes to, bring smokers into the lab, and then the smoker would have to pull the cigarette on this sliding apparatus into their mouth to take a drag.

This was done in the 1970s. They tried to measure this idea that they'd pull faster as the cigarette was almost in their mouth. Of course, you probably don't want this cigarette-laden apparatus to crash into your face, so they didn't find any results there.

There was another study that looked at people going into a bank to cash checks, and they tried to measure how fast they were walking. This highlights a difference between rats in a lab and humans, which is that we pace ourselves. You probably don't see people breaking into a run as they get to the door of a cafeteria. We know the reward is going to be there, and we decide how much effort to put in and how quickly to walk for these kinds of rewards that are already certain to us.

We wanted to test our idea that, in humans, this goal gradient was more likely to apply conceptually when we're thinking about the different goals in our life and how to prioritize them, how much effort to put into each one at what time. We thought a good laboratory for this motivational difference was loyalty programs.

Think "buy 10, get one free" coffee programs or airline frequent flier miles. If you think about the coffee program: You're thirsty, and you want to get something to drink. You could either go to the coffee shop downstairs where you have a loyalty card or you could go somewhere else. How you choose between those things might be affected by your trying to complete that coffee card. Our main study was in a "buy 10, get one free" coffee card program on campus. We managed this program, collected the cards, and measured how long it took people to come back for their next coffee as a function of how many stamps they already had on their card. When you have only one stamp on your card, nine to go, are you going to be less motivated, and therefore it'll take you longer to come back and buy another coffee, than if you already have eight stamps and only two left to go? That's exactly what we found.

Why do you think it is that people behave this way?

I think the way basic cognition is organized prioritizes things that are larger rewards and rewards that we're closer to achieving. And in rats, that plays out in a very simple and direct way. But for humans, everything we do is filtered through much more complex, higher-order cognition.

Another way of saying it would be that we're present-

biased, and that's actually part of what's going on. When you only have one stamp on your card, that's pretty far away, whereas when you only have two stamps to go, that coffee is imminent—you could get it really soon. And so it seems more valuable.

My guess is that we spontaneously think about goals more if they can be achieved sooner and that we also take them more seriously and value them more.

I would love it if you could talk about the "progress illusion" and how it relates to the progress illusion.

There's a lot of research showing that humans try to form judgments and use heuristics to simplify complex decisions. What that suggests is that maybe it's not the actual distance to the goal that matters in human behavior but our perception of that distance. And so the progress illusion is theoretically interesting as a way to test if motivation is about real goal proximity or subjective perception.

The basic idea is to hold constant the objective distance to the goal but make some people feel like the goal is pretty close and others feel like the goal is farther away. And so, in the study, we designed two different kinds of these coffee cards. One was a 12-stamp card, but we started people off with two free stamps. The other version was a standard card—just buy 10 coffees, get one free.

In both cases, when people get the card, they're 10 coffees away from receiving their reward. But in the first case, by framing it as 12 stamps and giving them two free stamps, they feel like they're already part of the way there.

People completed cards faster if they thought of it as the remaining 10 out of 12 as opposed to the full 10 required. You can see this in lots of different real-world settings. Plenty of rewards programs will give you free points to start.

Where do you think this finding matters outside of the domain of rewards programs? Could this even be important for people who are trying to pursue goals?

One of my colleagues, Devin Pope, has a great study looking at standardized testing. He looks at a setting where there are different tests on different days and the students know in advance which subject will be administered first, second, third or fourth.

He finds that students consistently score higher on the first test. The idea is that the week before, they're sitting there thinking about these four goals that they're trying to achieve, which is to do well on four different tests covering four different topics, and they focus their efforts on the one that's the closest. They think of the first topic, "Let me study really hard for that one." And they maybe overprioritize that first one.

This implies that understanding the goal gradient is important for managing our own motivation because it can be a double-edged sword. On the one hand, having a salient goal that we're committed to with a clear deadline or requirement is really motivating. It focuses our attention, gets us to muster our energy and really work on achieving that goal. It's a great source of motivation, and we can use that by setting up our goals in a way that we always have a goal in our sights that feels close.

The potential dark side of the goal gradient is that when we're really focused on the proximal goal, it can make us shortsighted, just like the students. And so, the flip side of understanding the goal gradient is realizing that it can be really helpful to motivate us to have this upcoming goal in our sights, but we want to make sure it's not blinding us to other, later goals that are equally or maybe even more important.

Is there anything you do differently in your life as a result of the research on this topic?

What I'd love to tell you is that I'm great at time management and at prioritizing projects and my work. Unfortunately, I'm the classic case of people studying what they're bad at because they find it fascinating.

I have a very long to-do list, and I use goal setting to try to prioritize. And then I struggle with how a goal that's really in your face can distract you from longer-term, potentially more important goals. If I'm working on multiple projects and one of them is with a co-author and I have a meeting with that co-author the next day, that seems like the most important thing in the world, even if there's something else that's a lot more urgent but where the next step in completing that goal is less salient or less immediate.

Have you found any cures for suffering from it? Do you do anything where you try to dodge it, or do you have any sophisticated tips you can offer?

The strategy I'd recommend, although I haven't tested it scientifically—I've tried to test it in my personal life, with mixed results—is to do goal prioritization with a bit of a colder mindset where you're thinking of all your goals as a little bit distant and trying to be objective about how important they are. And then take the most important goals and put them first on your list and think of ways to make those goals feel immediate.

We all have this intuition of knowing that this is helpful even if we don't know why. For goals that are really far off, try to break them up into pieces and focus on the part that you can complete soon to make progress on that motivating. And so if I'm writing a paper, thinking about the fact that, in the best case, it's going to be published two years from now might be demotivating.

But if instead I pick a day by which I want to have the first draft done, I'm going to reframe it in my head and feel more motivated.

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BEHAVIOR & SOCIETY

The Condoms of the Face: Why Some Men Refuse to Wear Masks

It's not the first time masculine ideology has driven resistance to a public health initiative

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In the midst of rapidly rising case counts and hospitalizations during the COVID-19 pandemic, a small but incredibly loud segment of U.S. society has adamantly refused to wear masks. Many of these people are men who seem to view masks as emasculating face condoms that must be rejected. For example, a look at Donald Trump's debacle of a rally in Tulsa, Okla., on June 20 shows that men in his base, like Trump himself, avoid wearing masks. Women such as Ivanka Trump, by contrast, can choose a mask or not because they have no masculinity to protect.

In reality, whether it is a mask or a condom, resistance to these barrier methods of protection—both of which keep the wearer from transmitting a virus to someone else—clearly presents a danger to public health. A man without a mask is willfully endangering people around him by refusing to block his spit and the viruses it could contain. Why would he take these risks to himself and to others?

When HIV emerged in the U.S., a key part of the public health response was to urge consistent condom use. Although the advice made obvious sense, in some pockets of the population, people resisted it. Researchers began to dig into the social factors that motivated this resistance. They found that among men who were having sex with

women, "masculine ideology" was associated with rejection of condom use.

At the time the research was being conducted, three factors were cited as the pillars of this ideology: status, toughness and antifemininity. Today the concept has been expanded a bit to encompass other features. The American Psychological Association has defined this ideology as a "particular constellation of standards" that demands that men ascribe to "adventure, risk, and violence." Certainly choosing not to wear the simplest of protective gear during a pandemic is both a risk and an adventure.

Perhaps not surprisingly, where this conceptualization of manliness prevails, the dominant avatars who embody it are white men with epic swagger. As one researcher described it, this "celluloid masculinity" muscling around on screens, perhaps most famously in the form of characters played by Arnold Schwarzenegger, represents a "dominant Western exemplar of manhood." These characters, you see, despite the copious body armor and weaponry they tote around in their films, would never, ever don simple barrier protection devices because viruses can sense fear.

In today's refusal to wear a mask, we see echoes of this condom rejection embedded in white masculine ideology. Led by the Masculinity Performer in Chief, these men are making what increasingly looks like the last stand for that celluloid masculinity. As in another infamous "last stand," they risk ending up dead on the battlefield they insisted on creating, along with the casualties they take with them.

Why do these men perform this mask-free celluloid masculinity in the literal face of a threat? The reason is that eschewing a mask sends a strong social signal in which the bare face is the performance. But who is the audience?

A lot of people are baffled by this behavior—at balking at something so basic, a disease-transmission preventive that has such a low barrier to access. Why do these men perform this mask-free celluloid masculinity in the literal face of a threat? The reason is that eschewing a mask sends a strong social signal in which the bare face is the performance. But who is the audience?

Understanding this behavior requires understanding the level of investment that these men have made in their masculine ideology. Trump, reality notwithstanding, is the high priest of this ideology. When he rejected masks, his became the performance to imitate. These men have made a deep commitment and probably engaged in some willful self-deception to remain loyal to Trump. Donning a mask would mean wasting their investment and the perceived fruits of all that self-compromise.

So they go maskless. In doing so, they expect that their masculine ideology group will accept them, respect them and not reject them.

The irony is that these men think they are manifesting the ideal of the rugged, individualistic American when their refusal really traces in part to a fear of what other people will think about them. Drunk on a toxic brew of self-interest and that masculine ideology, they mistake their refusal to protect themselves and others as a mark of character when instead it is a mark on their character.

Some people who would like to mitigate the harm of these behaviors have clearly recognized the value of turning to those personifications of celluloid masculinity. On June 18, California governor Gavin Newsom issued a statewide order requiring that people wear masks in public places. The hot reaction he drew would have been suitable if he had, say, required all Californians to adopt a baby cobra. There was even a briefly trending "recall Newsom" hashtag on Twitter.

Likely anticipating this bizarro-world backlash, Newsom joined forces with his surviving predecessors—Jerry Brown, Gray Davis, Pete Wilson and Arnold Schwarzenegger—to make a public service announcement urging people to wear masks. Each governor had a couple of lines to deliver. Schwarzenegger's lines were spoken with all the hypermasculine gravitas of his celluloid hero John Matrix: "This is not about being weak.... Just do it."

Gish Jen's most recent book is *The Resisters*, a novel. She is also author of *The Girl at the Baggage Claim: Explaining the East-West Culture Gap*.
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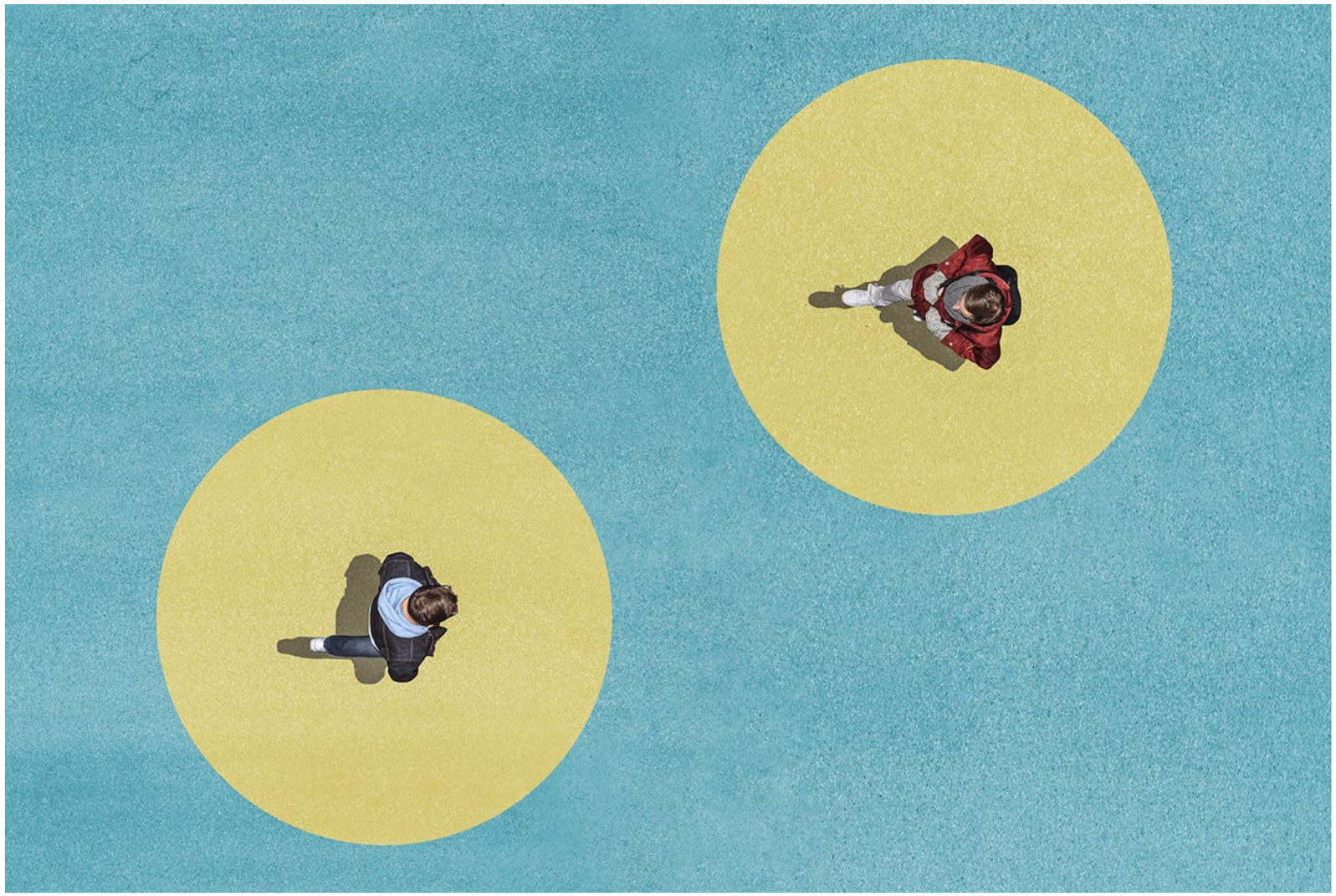
BEHAVIOR & SOCIETY

What Social Distancing Reveals about East-West Differences

The pandemic could spur psychological changes in both the U.S. and China



BERNHARD LANG *GETTY IMAGES*

Social distancing worries Americans. Yale University professor Nicholas Christakis warns that it asks us "to suppress our profoundly human and evolutionarily hard-wired impulses for connection," for example. And journalist Greg Miller and others cite possible ramifications that include "heart disease, depression, dementia and even death." In striking contrast, there has been little talk along these lines in mainland China. A search of Chinese social media yields almost no posts on the subject: shutdown-related concerns expressed are primarily about the safety of the individual and of their family and friends; change of lifestyle; boredom; physical confinement; and the resulting social conflict caused by close and extended interaction time while simultaneously managing work, child care and household tasks. A review of China's academic literature likewise yields no articles on the topic.

This may seem counterintuitive. Shouldn't the group-oriented Chinese have more social-distancing anxiety than Americans, not less? To give a little background: People in both Western and Eastern societies have social needs, which they meet in a variety of ways; however, the go-to strategies tend to differ. In the more individualistic West, we love our families, of course, but often rely heavily on friendship as well—on elective ties that reflect "who we really are." Conducive to personal growth, these friendships can coalesce into "chosen families."

But these relationships depend on nuanced in-person interaction, which, unfortunately, is made difficult by social distancing. Cornell University researchers Duyen Nguyen and Susan Fussell have shown that compared with the Chinese, Americans rely more on nonverbal behavioral cues such as head turns, facial expressions and eye contact to support communication. We can also be more skittish—more likely, for example, to attribute a lack of affirmative body language to a lack of interest or involvement. Because such subtle behavioral cues are poorly conveyed by electronic media, Americans now reliant on Zoom or FaceTime may find it hard to maintain a sense of connection with others.

In contrast, people in more collectivistic societies such as China's tend to meet their social needs with given or blood ties—with family or schoolmates, for example. Less personalized though they may be, these relationships also require less upkeep. Indeed, the laboratory run by one of us (Qi Wang) recently found that Asians can derive a sense of closeness from almost any kind of social exchange, including talking about the weather. A sense of connection is thus easily maintained even during long periods of social distancing.

That is not to say that epidemics do not distress the Chinese. They absolutely do, in both the short term and the long term. A study of the survivors of the 2003 SARS outbreak in Hong Kong, for example, found not only that survivors were traumatized but that even a year later they had "alarmingly high levels of depression, anxiety, and posttraumatic symptoms." Interestingly, though, this distress was linked only to the illness itself. Although social distancing was practiced in Hong Kong in 2003, its possible ill effects elicited little Chinese concern. Notably, research found that during the SARS pandemic, residents in Hong Kong in fact experienced increased social connectedness through their communities.

Might we Americans ever be as little distressed by social distancing as the Chinese? Possibly. Cultural phenomena such as individualism and collectivism are, of course, hugely complex and dynamic. No one can make predictions about them with certainty. Still, we might ask: Could the current pandemic and its ensuing economic fallout prove a large enough shock to temper our extreme American individualism—an individualism that has arguably reached the highest levels not only in the world but in human history? Perhaps. Already many college students have moved back in with their parents, altering their relationships in ways that could have ongoing effects. If nothing else, these adult children may become more keenly aware of the safety net that blood ties afford in a crisis.

What's more, a severe recession, should one set in, might draw various and sundry unemployed family members into active child raising. The nuclear family could become less nuclear; multigenerational households could proliferate, and the very young could emerge with a more collectivistic orientation—an orientation that has lain latent in many parts of America, overwhelmed by a dominant discourse that paints the U.S. as a nation of cowboys.

Ironically, the pandemic may have the opposite effect in China. A number of Chinese cities saw a sharp uptick in divorces—a long-accepted marker of individualism—following the lifting of their lockdown. Such is the demand for divorces in the southern city of Shenzhen that, according to the Chinese Web site *Sixth Tone,* "couples are having to make reservations a month in advance before they can get a divorce," and in a small city in Hunan, divorce-related administrators have been so busy they do not "even have time to drink water."

Of course, the stress of confinement contributed to some of these breakups. As in the U.S., there has been a surge in domestic violence. But some breakups appear traceable to the surfacing of individualistic thinking that, for example, stresses choice and voluntary effort and downplays duty and obligation. Thus, when 34-year-old Zhang Ning found herself stuck taking care of her son and in-laws alone in Wuhan for months on end, she was outraged by her husband. "When I called him wanting to release my emotions, at first he comforted me a bit, but then he became impatient," she told *Sixth Tone*. Then one day he snapped at her: "Aren't you supposed to do all this?"—a classic collectivistic reaction. And that, she reported, was that.

In short, although the Chinese may not experience social-distancing anxiety as we Americans do, the pandemic seems to have brought out individualistic ways of thinking in some. Of course, divorce rates and rationales can tell only a small part of the sprawling story that is China. Still, might the globalization that has drawn East and West so much closer together physically also, via the pandemic, draw us ever so slightly closer together psychologically as well? It's possible.

Esben Stærk is president of LEGO Education.

BEHAVIOR & SOCIETY

Building Kids' Resilience through Play Is More Crucial Than Ever

It helps with social, emotional, physical and cognitive skills—and with schools closed, it's more important than ever

With almost 70 percent of the world's student population impacted by school closures according to UNESCO, the long-term impact on individuals, the education system, the global workforce, and tools and technology can only be speculated about and hypothesized. What we do know is that building resilience among students is more important than ever.

The need for resilience is not new. For years educators have faced the challenge of preparing students for jobs and technology that do not even exist yet. The global pandemic will accelerate and influence many of these changes as schools and businesses integrate remote practices; as demand grows for science, technology, engineering, arts and math (STEAM) careers, especially in health care and automation; and as societies navigate the role and value of human interaction and collaboration. What was already an ambitious task for the global education system has been amplified, and the uncertainty today's students face is even greater.

Like any experiment or challenge we ask students to attempt, the goal is not to find one right answer and be done. True innovation comes from the iterative process of trying something, understanding why it did or did not work, and learning what to do differently or better. This process develops problem-solving, collaboration, creativity and critical thinking skills that build the resilience

RUSLAN DASHINSKY *GETTY IMAGES*

kids will need as students and as future employees, inventors and leaders.

It is easy to see why resilience is a critical skill, but how can we foster it? The answer might be more fun than you think: learning through play.

THE SCIENCE BEHIND PLAY

To many, play and learning are opposites. From research by the LEGO Foundation, we know that that does not have to be true. An evaluation of more than 50 educational approaches found many similarities with the learning-through-play model, which can be highly effective in building academic skills and engagement. Play provides an opportunity to build social (communication and collaboration), emotional (resilience and self-regulation) and physical (fine and gross motor) skills, as well as cognitive ones. This combination is critical to the holistic development of a child, with each skill domain having equal importance.

When successfully implemented in schools, learning through play becomes integral to everything from instructional design to administrative support to teacher skills training and professional development. Playful learning is intended to be part of the curriculum and is different from free play, which is what kids might do at recess or with toys at home. Students learning through play are simultaneously achieving educational outcomes that align with local, state and federal standards and guidelines. You can readily see the merits of a playful approach in STEAM, where students benefit from collaborative learning by using and connecting concepts and content with real-world applications.

It is easy to see why resilience is a critical skill, but how can we foster it? The answer might be more fun than you think: learning through play.

Consider learning about engineering design principles by listening to a lecture and completing a worksheet on how a factory conveyor belt works. Now imagine designing, building and programming a robotic system to create that conveyor belt and move a ball on a path that includes a 90-degree turn. The academic objectives are the same in both scenarios, but with the hands-on activity, students work together, troubleshoot, and physically manipulate the motors and sensors. It is academically meaningful, socially interactive, actively engaging, iterative and joyful—all of which are key characteristics of learning through play.

Academic performance is an important learning outcome, but it is not the only one. Soft skills are harder to quantify but have been shown to help build resilience in children. The LEGO Foundation found that the inherent joy and affective nature of play, along with its stimulation of multiple brain networks, make it particularly effective in maintaining and developing the social and emotional skills needed to deal with challenging and changing circumstances, as well as the resilience and creativity to adapt. Play can help students reduce anxiety, take control of their own situations, strengthen social relationships, reduce complexity and imagine positive scenarios. All of these are the underpinnings of the kind of resilience needed in 2020 and beyond.

DEVELOPING CONFIDENCE AND RESILIENCE

According to a Harris Interactive survey, 95 percent of teachers believe hands-on learning builds students' confidence. And with confidence comes resilience. The survey found that students who are confident learners often are more prepared to face adversity head-on. Hands-on activities typically involve trial and error, which gives students a safe environment to work through frustrations and "bounce back" if they do not get it right on their first attempt. Students build resilience through meaningful failure. A recent article from the *New York Times* articulates this well, sharing ideas for how to talk to children about failure in an approachable way. The author outlines a 2016 study co-authored by Kyla Haimovitz, a postdoctoral fellow at the University of Pennsylvania, and Carol Dweck of Stanford University in which they found that children are more easily derailed by their mistakes when their parents indicate that failure is shameful. In other words, when children are taught that mistakes are okay, they can learn how to work through them instead of giving up or getting hung up on them.

INTEGRATING PLAYFUL LEARNING AT HOME

The classroom is an ideal setting for playful, hands-on learning, but students do not have to miss out

on its benefits when they are at home or on summer break. There is an extensive assortment of free resources for ideas and activity starters online. Whether it is building with LEGO, learning the science behind gardening or storytelling with math, there is an activity to accommodate every type of learner, topic, interest, grade level, material and environment available.

Hands-on activities are also a great tool for teachers and parents concerned about screen time or struggling to keep students engaged and motivated. Teaching STEAM concepts does not have to be intimidating because adding play makes them more accessible for parent and child. It can be as simple as building airplanes or race cars from craft supplies to teach motion, friction and aerodynamics. Kids can test different theories to see which of their designs successfully fly or drive. A LEGO Education Master Educator teaches computational and algorithmic thinking by making a PB&J sandwich. This fun and tasty activity is easy to do at home. Have your child tell you how to make this iconic dish, but only do it exactly as they instruct you. This is the same way your child would program a robot to complete a task. You will both get a laugh when the direction is not discrete and you smear jelly on the table, not the bread. The more children experience these small failures through trial and error and eventually succeed, the more they develop the elasticity to bounce back.

THE FUTURE IS STEAM

The way we live and work has been changing in light of the Fourth Industrial Revolution. In a 2017 report, McKinsey estimated that by 2030 up to 375 million people may need to switch occupational categories and learn new skills. The pace of change is not slowing down, and many predict that the pandemic will only accelerate the adoption of automation. As a result, the demand for skilled workers will continue to grow, but will the pipeline of talent be there to support it?

Closing that growing skills gap starts in the classroom as we prepare students with the skills they need. Students need to learn technical STEAM skills such as engineering, coding and programming, as well as soft skills. In fact, problem solving, critical thinking and creativity top the list of skills needed to thrive, according to the World Economic Forum. These are also the skills that are uniquely human and that differentiate our role in an increasingly digital world.

These past few months have shown how rapidly our world can change and how valuable resilience and confidence continue to be. Through all this uncertainty, we have seen students, educators and parents rise to the occasion and embrace a growth mindset. These moments of resilience—big and small—will help lead the way forward, but our work does not stop there. Whether in living rooms and backyards or in physical or virtual classrooms, students need to continue building this resilience. With it, they will view challenges as opportunities, tap into their creativity and confidence to find solutions, and ultimately be better prepared to rebuild and reimagine the world around them.

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MENTAL HEALTH

Mental Health after COVID-19

In the wake of the pandemic, there will be an even greater need for help in the face of loss, isolation and trauma

GETTY IMAGES

As psychiatrists who have worked on the front lines of the pandemic, we have seen firsthand how the COVID-19 pandemic has ruthlessly tested the limits of our health care system. Just when the pandemic seems to be momentarily abating, the country is reckoning with another public health crisis—that of anti-Black racism and police violence. Emerging data show that COVID-19 disproportionately affects minority communities, likely because of racism's downstream effects on socioeconomic opportunities, health outcomes and insurance coverage.

With widespread social isolation, increasing unemployment and unprecedented levels of stress, we are witnessing an impending mental health crisis. These events have painfully unearthed the weaknesses of our system, but we as psychiatrists also see one hopeful prospect: recognition and improvement of American mental health care. Here are five ways that we believe COVID-19 could drive mental health innovation forward to create a more equitable system of care for people in the U.S.

THE POWER OF TELEHEALTH

Mental health clinics across the country have shut down in-person services, leading to a huge rise in the utilization of telemedicine solutions. Remarkably, both patients and clinicians alike have discovered that this form of clinical interaction can work and may even be preferable in some scenarios. Telehealth practice solutions such as Doxy.Me and Zoom For Health care, as well as startups such as Teladoc and Talkspace,

are seeing dramatic increases in demand.

Fueling the transition are loosening telehealth regulations. The Centers for Medicare and Medicaid Services (CMS) is temporarily reimbursing telehealth at the same rate as in-person treatment. "Originating site requirements," which require patients to be located at a health care facility to participate in telehealth visits, are suspended. States are also easing licensure requirements so that physicians can practice across state lines. An increasing number of telephonic visits are being reimbursed as well, and HIPAA enforcement is being relaxed so physicians can videoconference with their patients without excess worry.

Although telehealth reimbursement may begin to decrease as in-person visits resume, we predict that some regulations will stay loosened as the prominence of telehealth increases. The Medicare originating-site requirement, considered overly restrictive by many, may be dropped permanently. As patients and clinicians alike see the value of telehealth, its steadily increasing market share may be the easiest trend to spot in mental health care.

SUBSTANCE USE RESOURCES

People with substance use disorders (SUDs) are especially suffering from disruption to their treatment. Mainstays, including peer support groups, counseling sessions and periodic toxicology screens, are all severely interrupted. During the 2008 Great Recession, social isolation and economic depression led to a wave of opioid and illicit drug use that fueled the opioid epidemic. As we head into another recession, many health care professionals are particularly worried about their clients relapsing or increasing their use.

Thankfully, technology has enabled in-home access to substance use supports. Peer support groups such as Alcoholics Anonymous and Smart Recovery are operating nearly all of their groups through video, and methadone clinics are now able to dispense weeks' worth of methadone to clients. Buprenorphine, another medication-assisted therapy for opiate use disorder, can now initially be prescribed online. Online substance use programs, such as Lionrock Recovery, have seen demand rise by over 40 percent. Even as some communities reopen clinical services, there will still be intense market pressure for comprehensive home-based solutions to substance use treatment.

CONTINUUM OF CARE

A huge problem in U.S. behavioral health care is the lack of intermediate care options. In the continuum of care, treatment resources cluster around outpatient treatment, such as weekly therapy with a counselor, and inpatient treatment, such as admission to a psychiatric hospital. Intermediate care options such as intensive outpatient programs (IOPs) and partial hospital programs (PHPs) offer a way for patients to be engaged in intensive therapy, medication management and group support but do not require patients to be admitted for a costly hospitalization.

Across the country many IOPs and PHPs have converted to telehealth because of COVID-19. In New York State, strict billing requirements associated with PHPs that prevented their widespread availability have now been loosened. We believe that online intermediate care models should continue outside of this pandemic, especially for patients in rural states where access to such care has traditionally lagged. The demand for intermediate care options that increase outpatient support and prevent hospital admissions will expand the menu of treatment options past simple weekly therapy.

PERSONALIZED DATA

To place someone in the appropriate treatment option, we must be able to quantify that person's risk and needs. Mental health providers are traditionally bad at predicting or quantifying risk, including suicide risk. Part of this inability to assess risk has been the historical struggle with the implementation of measurement-based care, defined as the ability to quantify symptoms of patients with mental illness. The COVID-19 crisis and the increasing utilization of digital tools can help researchers discover new markers of impending decompensation. We can also better understand the types of digital tools that people find effective for their mental health treatment. We hope this information will help us to develop risk-informed treatment plans and more precise delivery of care.

INTRODUCING PUBLIC MENTAL HEALTH

Public mental health focuses on preventing mental illness instead of simply treating it. Because COVID-19 can be classified as a collective trauma, Americans are at risk of developing post-traumatic stress from the pandemic. Compounded with the inequitable outcomes we are seeing

across Black and brown communities, such stress may be worsening our existing mental health disparities. The mental health consequences of COVID-19 could lead to long-term losses in well-being, economic productivity and health care costs. Unfortunately, the existing U.S. mental health system is sorely lacking a public focus: it engages largely with those who are already mentally ill and often only with those who are able to pay for treatment.

We believe that to reduce long-term economic and social impact, payers and government will need to increase funding of public mental health programs that prevent illness and increase treatment access. To be effective, these programs must offer access to those without financial resources or with serious mental illness and commit to best practices when treating underserved populations. Tech-enabled services that can assist with risk stratification, offer support before illness develops or connect people with accessible mental health treatment are slowly arriving, such as NYC Well, which offers a "front door" to support services for New Yorkers in mental duress. For tech-enabled solutions to soar, however, structural change that closes the gaps in funding and infrastructure must occur.

In the midst of the devastation, we remain hopeful that mental health care will transform. As our country confronts a calamitous loss of life, widespread isolation and deep social fractures, there will be an even greater need for mental health services. A functioning mental health care system will be critical in supporting our communities.

Susana Martinez-Conde and **Stephen Macknik** 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*.

COGNITION

Unveiling the Illusion

How Giovanni Strazza rejected reality to make marble lifelike

The depiction of intricate folds in loose hanging fabric is a recurring theme in the history of sculpture. From the *Winged Victory of Samothrace* in the 2nd century B.C.E., to Michelangelo's *Pietà,* to Karen LaMonte's drapery abstractions, a main challenge for artists has been to convey weightlessness and flow with such compact materials as steel and stone.

The *Veiled Virgin,* a 19th-century work by Italian sculptor Giovanni Strazza, demonstrates the extreme of this ambition as one of the most exquisite illustrations of marble made ethereal.

Hewn from a block of Carrara marble and housed since 1862 in the Presentation Convent in Newfoundland, Canada, the sculpture is a bust of the Virgin Mary with her gaze downcast as if in prayer or sorrow and her features shrouded by the thinnest and most translucent veil.

Giovanni Strazza's sculpture *Veiled Virgin* (*left*). Features identified as face (*blue*) versus fabric *(yellow*) by research participants (*right*).

FLIP PHILLIPS, ROLAND FLEMING AND WANITA BATES

Although every layer in the sculpture is made of the same solid piece of rock, observers can perceptually separate the fabric of the veil from Mary's facial features with little effort. This remarkable skill is not limited to draped faces but also applies to a great variety of objects, according to a recent study by Flip Phillips of the Rochester Institute of Technology and Roland Fleming of Justus Liebig University Giessen in Germany.

The scientists were surprised about the consistency with which viewers mentally segregated the layers of all kinds of arbitrary items, not just the *Veiled Virgin*. "It seems to be a generic ability and not specific to familiar objects and materials," Phillips says.

Phillips and Fleming also realized that to credibly suggest transparency, Strazza's carving strayed from the geometry of real drapery. Specifically, his portrayal of the *Veiled Virgin* alternates between rendering the true shape of an overlying textile and that of the face underneath as if it were unobstructed by material. One example is Mary's left eye, which Strazza rendered as if uncovered by fabric except for a few narrow ridges depicting the cloth.

Sculptors do not duplicate reality, Phillips points out. "They exaggerate some geometric features, minimize others, manipulate the surface qualities by burnishing and polishing" in the service of creating the illusion of two or more different materials (such as cloth or skin) with just an unrelated, single material to manipulate (such as marble). "This is fascinating," he says.

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