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# SCIENTIFIC AMERICAN MIND

SPECIAL REPORT

## THE NEW SCIENCE OF CONSCIOUSNESS

What is it? A stream of unconscious thought, synced vibrations or just an illusion?

PLUS

THE LEGACY OF NAZI PARENTING

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WITH COVERAGE FROM nature

FROM THE EDITOR

LIZ TORMES

# The Illusion of Mind

It may be one of the greatest scientific mysteries yet to be solved: What is consciousness? It's an explanatory gap that still plagues neuroscientists—that is, what forges the relationship between the brain and the subjective sensations we call "feelings" or "awareness?" In a special report in this issue, we include several fresh takes on what gives humans, at the very least, consciousness. In one article, Peter Carruthers sits down with editor Steve Ayan to explain his hypothesis that consciousness is mostly an illusion (see "There Is No Such Thing as Conscious Thought"); the thoughts and feelings that arise in your mind are a result of unconscious mental processes operating behind the scenes. You feel you know your own mind, but it's truly operating automatically. Dare I say the mind has a mind of its own?

Ayan further explores this idea in his article "The Brain's Autopilot Mechanism Steers Consciousness." Consciousness is only an impression of immediacy, he writes. We become aware of our consciousness when the brain's background activities and predictions conflict with reality. Another fun idea that has come together in the past decade is that synchronized vibrations among living creatures are at the heart of human consciousness. Read more in Tam Hunt's article "The Hippies Were Right! It's All about Vibrations, Man!" As always, I hope you enjoy this issue, as much as your conscious mind allows.

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VICTOR TONGDEE *GETTY IMAGES*

On the Cover

**The New Science of Consciousness**

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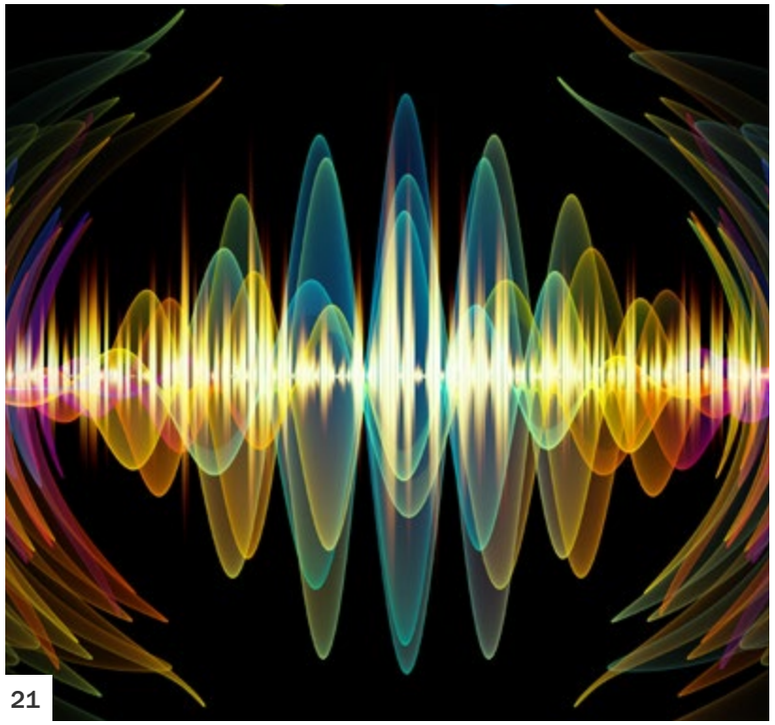

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## FEATURES



## OPINION

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## How Dad's Stresses Get Passed Along to Offspring

**Mouse studies show tiny intercellular pods convey to sperm a legacy of a father's hard knocks in life**

A STRESSED-OUT and traumatized father can leave scars in his children. New research suggests this happens because sperm "learn" paternal experiences via a mysterious mode of intercellular communication in which small blebs break off one cell and fuse with another.

Carrying proteins, lipids and nucleic acids, these particles ejected from a cell act like a postal system that extends to all parts of the body, releasing little packages known as extracellular vesicles. Their contents seem carefully chosen. "The cargo inside the vesicle determines not just where it came from but where it's going and what it's doing when it gets there," says Tracy Bale, a neurobiologist at the University of Maryland School of Medicine.

Preliminary research by Bale and others, announced in November at the annual meeting of the Society for Neuroscience in San Diego, shows how extracellular vesicles can regulate brain circuits and help

diagnose neurodegenerative diseases—in addition to altering sperm to disrupt the brain health of resulting offspring.

Striking evidence that harsh conditions affect a man's children came from crop failures and war-ravaged Europe more than a century ago. In those unplanned human experiments, prolonged famine appeared to set off a host of health changes in future generations, including higher cholesterol levels and increased rates of obesity and diabetes. To probe the inheritance of such changes at the cellular level, Bale and her co-workers performed a series of mouse experiments.

It is pretty easy to stress out a mouse. Stick one into a tube it cannot wriggle out of, soak its bedding or blast white noise—and stress hormone levels shoot up, much as they do in people worrying about finances or facing incessant pressure at work. Remarkably, the way a mouse physiologically responds to stress looks noticeably different if—months before conception—its father endured a period of stress. Somehow "their brain develops differently than if their dad hadn't experienced that stress," says Chris Morgan, a postdoc in Bale's lab who helped create the mouse model.

**The big question is how information about the paternal environment reaches the womb in the first place.**

The big question is how information about the paternal environment reaches the womb in the first place. After all, Morgan says, the "dad is only in there for one night, perhaps just a few hours." Could his sperm carry memories of prior trauma? The idea seemed reasonable yet controversial. Because DNA is packed so tightly in the nucleus of a sperm cell, "the thought that [the cell] would respond to anything in the environment really boggled people's minds," says Jennifer Chan, a former Ph.D. student in Bale's lab who is now a postdoc at Icahn School of Medicine at Mount Sinai in New York City.

Rather, there must be some other kind of cell whose DNA does react to environmental changes—and that cell, she reasoned, could then relay that information to sperm cells to transmit at fertilization. She focused on a population of cells that interact with developing sperm by releasing molecules that help sperm grow and mature. They also secrete extracellular vesicles—and Chan showed it is these vesicles whose contents fuse with sperm cells, instilling memories of a dad's prior stress.

In one set of experiments Chan stressed a group of male mice, let them mate and looked at stress responses in the pups. The clincher was a set of in vitro fertilization–like experiments in which she collected sperm from a male mouse that had never experienced induced stress. Half his sperm went into a lab dish with vesicles previously exposed to stress hormones. The other half was cultured with vesicles that had no contact with stress hormones.

Chan injected sperm cells from each batch into eggs from a nonstressed female, then implanted the fertilized eggs—zygotes—into the same foster mom. The pups from nonstressed zygotes developed normally. Pups from stress-exposed zygotes, however, showed the same abnormal stress response as those whose dads had experienced stress before mating. That showed extracellular vesicles act as the conduit for transmitting paternal stress signals to the offspring, Chan says.

The findings are "novel and of very high impact, especially when we consider the impact of military service or other work environments that can confer high stress," says Robert Rissman, a neuroscientist at the University of California, San Diego, who was not involved with the research. "I think it would be important to better understand the specificity of the effect and how different types of stressors or strength of stressors can modulate this system."

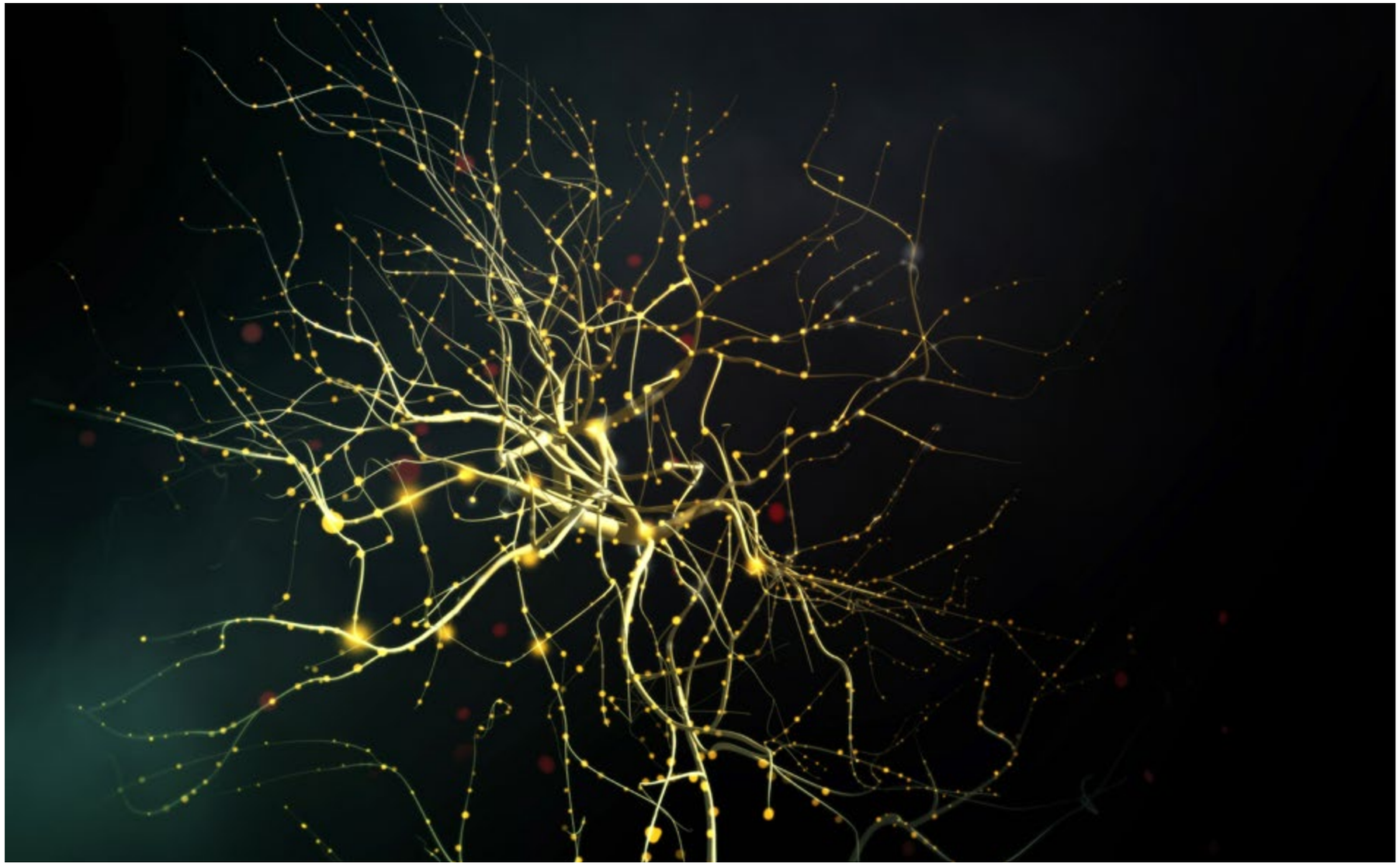
As a first step toward translating the findings to people, Morgan is collaborating with University of Pennsylvania psychiatrist Neill Epperson to track protein and RNA changes in human sperm samples. At the neuroscience meeting, Morgan presented data from a six-month study of 20 undergraduate and graduate students. Each month the participants came in and gave a sperm donation. They also completed a same-day survey asking how stressed they were feeling. Preliminary data suggest just several

months after a student reports stress, his sperm shows changes in "small noncoding RNAs"—RNA molecules that do not get translated to protein but instead control which genes get turned on or off.

Analyzing sperm from this group of healthy young men, the researchers plan to build a basic understanding of molecular changes linked with mild stresses such as taking final exams. In the future Bale and her colleagues hope to compare these baseline fluctuations with changes induced by more prolonged life stressors such as post-traumatic stress disorder or neurological diseases such as autism and schizophrenia.

The molecular signatures in extracellular vesicles may also help researchers discover new ways to noninvasively diagnose or predict adverse health outcomes in offspring, says Gerlinde Metz, who studies transgenerational inheritance of stress responses at the University of Lethbridge in Alberta and was not involved with the research. If so, the vesicles could become the basis for a pioneering type of stress test.

*—Esther Landhuis*



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## Deep-Brain Recordings May Show Where Unhappiness Lives

**New recordings of electrical activity in the brain help reveal the underpinnings of bad moods**

NEUROSCIENTISTS ARE coming closer to understanding why some bad moods seem to tumble uncontrollably through your head like a collapsing chain of dominoes. One misbegotten thought after another drives you to imagine frightful things to come or to relive your shameful past: "Remember that one thing five years ago? Wow, I really am a loser."

The spiral into such a mood may occur in a brain network that connects two key regions involved with memory and negative emotions, says psychiatrist Vikaas Sohal of the University of California, San Francisco. In a study he co-authored, published in November in *Cell*, Sohal

says he was able to tell if someone's mood was getting worse just by looking at whether this network was active or not.

Psychiatrists have previously used MRI scans to probe the human brain and the world of emotions within it. This technology can show how brain activity changes within a few seconds, but the brain tends to work a lot faster than that—neurons can fire dozens of times a second. MRI readings might miss things that happen too quickly. Implanted electrodes, however, can measure changes in brain activity up to 1,000 times a second. So when U.C.S.F. neurosurgeon Edward Chang popped into Sohal's office with an idea to use internal electrodes to elucidate the neurological underpinnings of mood, Sohal was delighted.

The brain surgery needed to implant electrodes is too risky to perform on healthy individuals for a study like this—but Chang works on epilepsy patients who need them anyway. When other treatments do not work, temporarily implanted electrodes can show what part of the brain is causing seizures, allowing Chang to cut that section out during surgery. By asking such patients to report their moods every few hours, the researchers hoped they could use the electrodes to get a rare window into emotion and the deep brain. "We know that mood is somewhere in the brain," Sohal says. His goal was "to see if we can find patterns of activity that tell us what mood is."

Chang implanted electrodes on the surfaces and inside the brains of 21 patients with epilepsy, recording the organs' activity continuously for seven to 10 days. Then Sohal scoured the recordings for instances when electrodes in different parts of a brain showed identical measurements of electrical activity. "Electrical activity of the brain looks like wiggles" from each electrode when displayed on a graph, Sohal says. "You ask, 'Okay, do the size of those wiggles and the locations of the peaks go up together in sync across two electrodes?'" If they do, it suggests those brain regions are communicating. "We call that a network," Sohal says.

One particular network connecting the hippocampus (an area linked to recollection) and the amygdala (an area linked to negative feelings) began appearing over and over, Sohal says. "That was our first big 'Aha!' moment." Whenever these two brain regions created synchronized electrical pulses that fluctuated between 13 to 30 times a second, people reported their moods getting worse. "We basically found that when there is less activity in this network, mood is more positive. When there's a lot of activity in this network, mood is negative," Sohal says.

**"People have a very vague idea of what it means to perceive or have an emotion in the brain."**

***—Brendon Watson***

The finding brings scientists closer to understanding how the brain creates bad moods, says Brendon Watson, a psychiatrist and neuroscientist at the University of Michigan who was not involved with the study. "There's a major open question in psychiatry: How do you construct emotion or mood? People have a very vague idea of what it means to perceive or have an emotion in the brain," he says, calling the new study "a great step for neuroscience."

Sohal says his team's findings spark ideas about how the brain generates negative moods. It is possible, for example, that when these two brain regions work together they create a vicious cycle that drags you down a bad road. "It's easy to imagine that you might be feeling bad, and then remembering bad experiences, and then feeling worse," Sohal says. "It's speculative, but that's really at the heart of how we think about experiences related to depression and anxiety."

If that is right, doctors might figure out how to interrupt that cycle with deep-brain stimulation or electroshock therapy for people with major depressive and anxiety disorders, Watson says. "If this is the part of the brain that makes you feel bad, maybe you could reverse how that's firing and get yourself to feel better," he says, adding it will be a long slog before this knowledge could be used in the clinic. "You would need to show that the network correlates with depression and bipolar episodes," he says, "Then study [this therapy] in rats and maybe, if you could convince patients, try studying it in people."

*—Angus Chen*

# Bad First Impressions Are Not Set in Stone

**People are more willing to change their mind about people they initially deem "nasty" versus those they deem "nice"**

COMMON WISDOM HOLDS that negative first impressions are hard to shake—and some research backs this up. But such studies often unfairly compare impressions based on immoral deeds that are extreme and relatively rare (such as selling drugs to kids) with impressions based on kindnesses that are more common (such as sharing an umbrella). A new set of studies involving precisely balanced behaviors finds that people are more willing to change their mind about individuals who initially come off as selfish than about those they deem selfless.

In three of the experiments, 336 laboratory and online participants read about two people who each made a series of 50 decisions regarding how many electric shocks to give someone in exchange for money. One fictional subject required more money per shock than the average person did to inflict pain on others. The other's price-per-shock threshold was comparably lower than the average person's. Study participants read about each subject's decisions one at a time. Before seeing each decision, they predicted what it would be. After every three decisions the fictional subject made, participants rated the individual on a scale from "nasty" to "nice," then specified their confidence in the rating.

As expected, participants rated the person who gave shocks for a lower price as nastier than the higher-price shocker. But they expressed less confidence in the "nasty" ratings, and their predictions of how many shocks that person would give fluctuated more. In other words, their beliefs about the "bad" subject were more changeable. "A well-designed brain system would not write someone off completely at the first sign of trouble," says Molly Crockett, a psychologist at Yale University, who co-authored a paper about the new set of studies, published in October in *Nature Human Behaviour*. An open mind helps people forgive and form bonds, Crockett adds.

The test scenarios are a far cry from real-world interactions. Still, the experiment offers "a really elegant paradigm that drills down on a question that's so central to our everyday human life," says Peter Mende-Siedlecki, a psychologist at the University of Delaware, who was not involved in the study. Crockett suspects the findings about social impressions reflect a general mental process of absorbing more information in threatening situations. She describes the resultant social tendency as a double-edged sword: "It's very good for conflict resolution—but at the same time it could trap you in a bad relationship."

*—Matthew Hutson*

THOMAS FUCHS

# Alzheimer's Attack on the Brain May Vary with Race

**A new study finds African-Americans with dementia have less buildup of certain toxic proteins in their brains than do whites**

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RESEARCH ON Alzheimer's has mainly focused on Caucasians. New findings, however, suggest the disease process that leads to dementia may differ in African-Americans. According to a study published in January in *JAMA Neurology*, the brains of African-Americans diagnosed with Alzheimer's have less buildup of a protein called tau—one of the two hallmark proteins that characterize the disease.

It is not clear why African-Americans would have less tau while still suffering from Alzheimer's, says neurologist John Morris, who led the research. But the finding is significant because it means the medical community needs to exercise caution when defining Alzheimer's by measures of tau buildup alone. The study also suggests race might affect other aspects of the disease's pathology, says Morris, who directs the Knight Alzheimer Disease Research Center at Washington University in Saint Louis. "The study of Alzheimer's disease, which really began formally in the United States in the mid-1980s, has largely been of white people," he notes. "The U.S. in general and the older adult portion of the U.S. population is increasingly diverse, so we really do need to study all populations to try to understand the disease and its forms."

For the moment, the differences detected in the disease's pathology will not change existing treatment protocols, which do not yet look at certain aberrant proteins to make a diagnosis. Physicians today diagnose Alzheimer's largely based on a patient's neuropsychological charac-

teristics. But once researchers have developed a more practical way to measure levels of key proteins involved in the disease, such differences could be crucial for accurate diagnoses, Morris says. Brain scans can detect tau as well as amyloid beta—another protein that builds up in the brains of Alzheimer's sufferers—but the scans are expensive and not widely available.

The study found no racial difference in amyloid levels. African-American study participants, though, had a much lower concentration of tangled clumps of the tau protein, whether or not they had dementia. The research looked at 1,255 people—some with Alzheimer's, some cognitively normal—including 173 African-Americans.

The study also found that a variant of a gene called *APOE4*, which confers a high risk of Alzheimer's in whites, seemed to be less of a peril for African-Americans. The latter tended to have much lower tau levels if they had the *APOE4* variant, suggesting they suffered less neurological damage because of the lesser tau exposure. "The mechanism may be different in AfrIcan-Americans than it is in whites," Morris says. Alzheimer's occurs more often in black Americans, even if the gene itself is more benign. Morris says some blacks may be more likely to wait until advanced stages of the disease before seeking medical care.

Other research has suggested *APOE4* provides some protection against infectious diseases including malaria, and that the gene is more common in people whose ancestors came to the U.S. from tropical climates where those diseases are more frequent. Among the Saint Louis study participants, African-Americans were just as likely to have the *APOE4* gene as were Caucasians. But in an earlier study in Atlanta that also looked at tau and *APOE4*, black Americans with dementia were far more likely to carry *APOE4.* African-Americans had lower levels of tau in both studies.

Tau may accumulate differently in the brains of African-Americans because of genetic differences between the races or because of the chronic stress of racism and other factors, notes William Hu, a neurologist and researcher at Emory University School of Medicine who led the earlier study. It is unclear what the mechanism might be, but African-Americans are known to have a different response to inflammation than whites, he says. "There may be a different inflammatory response that would lead to a different tau-based response."

In the new research, tau was measured in cerebrospinal fluid. Patients also underwent PET brain scans to measure amyloid buildup, MRIs to gauge brain volume, genetic testing for *APOE4* status and other clinical evaluations. "This is a critically important study as we move toward the goal of individualized medicine," Hu says.

If lower levels of the tau protein mean a patient has less Alzheimer's-related damage to the brain, as research suggests, African-Americans with these relatively low levels might be more responsive to drugs that are being developed to attack amyloid, Hu says. Amyloid tends to aggregate before tau in the disease process.

These regional research efforts, Hu says, should spur a nationwide study that examines how race affects various aspects of disease progression. Such a study, he adds, should be designed with a proportionally higher number of black participants to make the findings statistically valid. The race a person checks off on a form is a crude biological measure. Eventually, he says, this type of study will define groups by genetic makeup rather than self-described race to account for the many individuals of mixed heritage.

Morris also urges more investigation to understand how Alzheimer's acts in diverse groups of people. "I hope this publication will stimulate the need for our research efforts to become more welcoming to people of color," he says, "and not settle for enrolling individuals who are fairly easy to enroll: upper-class whites."

Keith Fargo, the director of scientific programs and outreach for the Alzheimer's Association, says the study is a reminder that measuring protein levels in the brain and other advances should not be used yet in physicians' offices until they are better understood. "It's a good idea to continue to measure these biomarkers in all different kinds of people—and not get too far ahead of ourselves in terms of clinical practice," he says.

*—Karen Weintraub*

# There Is No Such Thing as Conscious Thought

**Philosopher Peter Carruthers insists that conscious thought, judgment and volition are illusions. They arise from processes of which we are forever unaware**

*By Steve Ayan*

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**Steve Ayan** is a psychologist and an editor at *Gehirn&Geist*.

Peter Carruthers, Distinguished University Professor of Philosophy at the University of Maryland, College Park, is an expert on the philosophy of mind who draws heavily on empirical psychology and cognitive neuroscience. He outlined many of his ideas on conscious thinking in his 2015 book *The Centered Mind: What the Science of Working Memory Shows Us about the Nature of Human Thought*. More recently, in 2017, he published a paper with the astonishing title of "The Illusion of Conscious Thought." In the following excerpted conversation, Carruthers explains to editor Steve Ayan the reasons for his provocative proposal.

**What makes you think conscious thought is an illusion?**

I believe that the whole idea of conscious thought is an error. I came to this conclusion by following out the implications of the two of the main theories of consciousness. The first is what is called the Global Workspace Theory, which is associated with neuroscientists Stanislas Dehaene and Bernard Baars. Their theory states that to be considered conscious a mental state must be among the contents of working memory (the "user interface" of our minds) and thereby be available to other mental functions, such as decision-making and verbalization. Accordingly, conscious states are those that are "globally broadcast," so to speak. The alternative view, proposed by Michael Graziano, David Rosenthal and others, holds that conscious mental states are simply those that you know of, that you are directly aware of in a way that doesn't require you to interpret yourself. You do not have to read your own mind to know of them. Now, whichever view you adopt, it turns out that thoughts such as decisions and judgments should not be considered to be conscious. They are not accessible in working memory, nor are we directly aware of them. We merely have what I call "the illusion of immediacy"—the false impression that we know our thoughts directly.

**One might easily agree that the *sources* of one's thoughts are hidden from view—we just don't know where our ideas come from. But once we have them and we know it, that's where consciousness begins. Don't we have conscious thoughts at least in this sense?**

In ordinary life we are quite content to say things like "Oh, I just had a thought" or "I was thinking to myself." By this we usually mean instances of inner speech or visual imagery, which are at the center of our stream of consciousness—the train of words and visual contents represented in our minds. I think that these trains are indeed conscious. In neurophilosophy, however, we refer to "thought" in a much more specific sense. In this view, thoughts include only nonsensory mental attitudes, such as judgments, decisions, intentions and goals. These are amodal, abstract events, meaning that they are not sensory experiences and are not tied to sensory experiences. Such thoughts never figure in working memory. They never become conscious. And we only ever know of them by interpreting what does become conscious, such as visual imagery and the words we hear ourselves say in our heads.

**So consciousness always has a sensory basis?**

I claim that consciousness is always bound to a sensory modality, that there is inevitably some auditory, visual or tactile aspect to it. All kinds of mental imagery, such as inner speech or visual memory, can of course be conscious. We see things in our mind's eye; we hear our inner voice. What we are conscious of are

the sensory-based contents present in working memory.

**In your view, is consciousness different from awareness?**
That's a difficult question. Some philosophers believe that consciousness can be richer than what we can actually report. For example, our visual field seems to be full of detail—everything is just there, already consciously seen. Yet experiments in visual perception, especially the phenomenon of inattentional blindness, show that in fact we consciously register only a very limited slice of the world. [*Editors' note: A person experiencing inattentional blindness may not notice that a gorilla walked across a basketball court while the individual was focusing on the movement of the ball.*] So, what we think we see, our subjective impression, is different from what we are actually aware of. Probably our conscious mind grasps only the gist of much of what is out there in the world, a sort of statistical summary. Of course, for most people consciousness and awareness coincide most of the time. Still, I think, we are not directly aware of our thoughts. Just as we are not directly aware of the thoughts of other people. We interpret our own mental states in much the same way as we interpret the minds of others, except that we can use as data in our own case our own visual imagery and inner speech.

**You call the process of how people learn their own thoughts interpretive sensory access, or ISA. Where does the interpretation come into play?**
Let's take our conversation as an example—you are surely aware of what I am saying to you at this very moment. But the interpretative work and inferences on which you base your understanding are not accessible to you. All the highly automatic, quick inferences that form the basis of your understanding of my words remain hidden. You seem to just hear the meaning of what I say. What rises to the surface of your mind are the results of these mental processes. That is what I mean: The inferences themselves, the actual workings of our mind, remain unconscious. All that we are aware of are their products. And my access to your mind, when I listen to you speak, is not different in any fundamental way from my access to my own mind when I am aware of my own inner speech. The same sorts of interpretive processes still have to take place.

**Why, then, do we have the impression of direct access to our mind?**
The idea that minds are transparent to themselves (that everyone has direct awareness of their own thoughts) is built into the structure of our "mind reading" or "theory of mind" faculty, I suggest. The assumption is a useful heuristic when interpreting the statements of others. If someone says to me, "I want to help you," I have to interpret whether the person is sincere, whether he is speaking literally or ironically, and so on; that is hard enough. If I also had to interpret whether he is interpreting his own mental state correctly, then that would make my task impossible. It is far simpler to assume that he knows his own mind (as, generally, he does). The illusion of immediacy has the advantage of enabling us to understand others with much greater speed and probably with little or no loss of reliability. If I had to figure out to what extent others are reliable interpreters of themselves, then that would make things much more complicated and slow. It would take a great deal more energy and interpretive work to understand the intentions and mental states of others. And then it is the same heuristic transparency-of-mind assumption that makes my own thoughts seem transparently available to me.

**What is the empirical basis of your hypothesis?**
There is a great deal of experimental evidence from normal subjects, especially of their readiness to falsely, but unknowingly, fabricate facts or memo-

## MORE TO EXPLORE

**The Opacity of Mind: An Integrative Theory of Self-Knowledge.** Peter Carruthers. Oxford University Press, 2011.

**The Centered Mind: What the Science of Working Memory Shows Us about the Nature of Human Thought.** Peter Carruthers. Oxford University Press, 2015.

**The Illusion of Conscious Thought.** Peter Carruthers in *Journal of Consciousness Studies*, Vol. 24, Nos. 9–10, pages 228–252; 2017.

ries to fill in for lost ones. Moreover, if introspection were fundamentally different from reading the minds of others, one would expect there to be disorders in which only one capacity was damaged but not the other. But that's not what we find. Autism spectrum disorders, for example, are not only associated with limited access to the thoughts of others but also with a restricted understanding of oneself. In patients with schizophrenia, the insight both into one's own mind and that of others is distorted. There seems to be only a single mind-reading mechanism on which we depend both internally and in our social relations.

**What side effect does the illusion of immediacy have?**

The price we pay is that we *believe* subjectively that we are possessed of far greater certainty about our attitudes than we actually have. We believe that if we are in mental state X, it is the same as being in that state. As soon as I *believe* I am hungry, I am. Once I believe I am happy, I am. But that is not really the case. It is a trick of the mind that makes us equate the act of thinking one has a thought with the thought itself.

**What might be the alternative? What *should* we do about it, if only we could?**

Well, in theory, we would have to distinguish between an experiential state itself on the one hand and our judgment or belief underlying this experience on the other hand. There are rare instances when we succeed in doing so: for example, when I feel nervous or irritated but suddenly realize that I am actually hungry and need to eat.

**You mean that a more appropriate way of seeing it would be: "I think I'm angry, but maybe I'm not"?**

That would be one way of saying it. It is astonishingly difficult to maintain this kind of distanced view of oneself. Even after many years of consciousness studies, I'm still not all that good at it (*laughs*).

**Brain researchers put a lot of effort into figuring out the neural correlates of consciousness, the NCC. Will this endeavor ever be successful?**

I think we already know a lot about how and where working memory is represented in the brain. Our philosophical concepts of what consciousness actually is are much more informed by empirical work than they were even a few decades ago. Whether we can ever close the gap between subjective experiences and neurophysiological processes that produce them is still a matter of dispute.

**Would you agree that we are much more unconscious than we think we are?**

I would rather say that consciousness is not what we generally think it is. It is not direct awareness of our inner world of thoughts and judgments but a highly inferential process that only gives us the impression of immediacy.

**Where does that leave us with our concept of freedom and responsibility?**

We can still have free will and be responsible for our actions. Conscious and unconscious are not separate spheres; they operate in tandem. We are not simply puppets manipulated by our unconscious thoughts, because obviously, conscious reflection does have effects on our behavior. It interacts with and is fueled by implicit processes. In the end, being free means acting in accordance with one's own reasons—whether these are conscious or not. M

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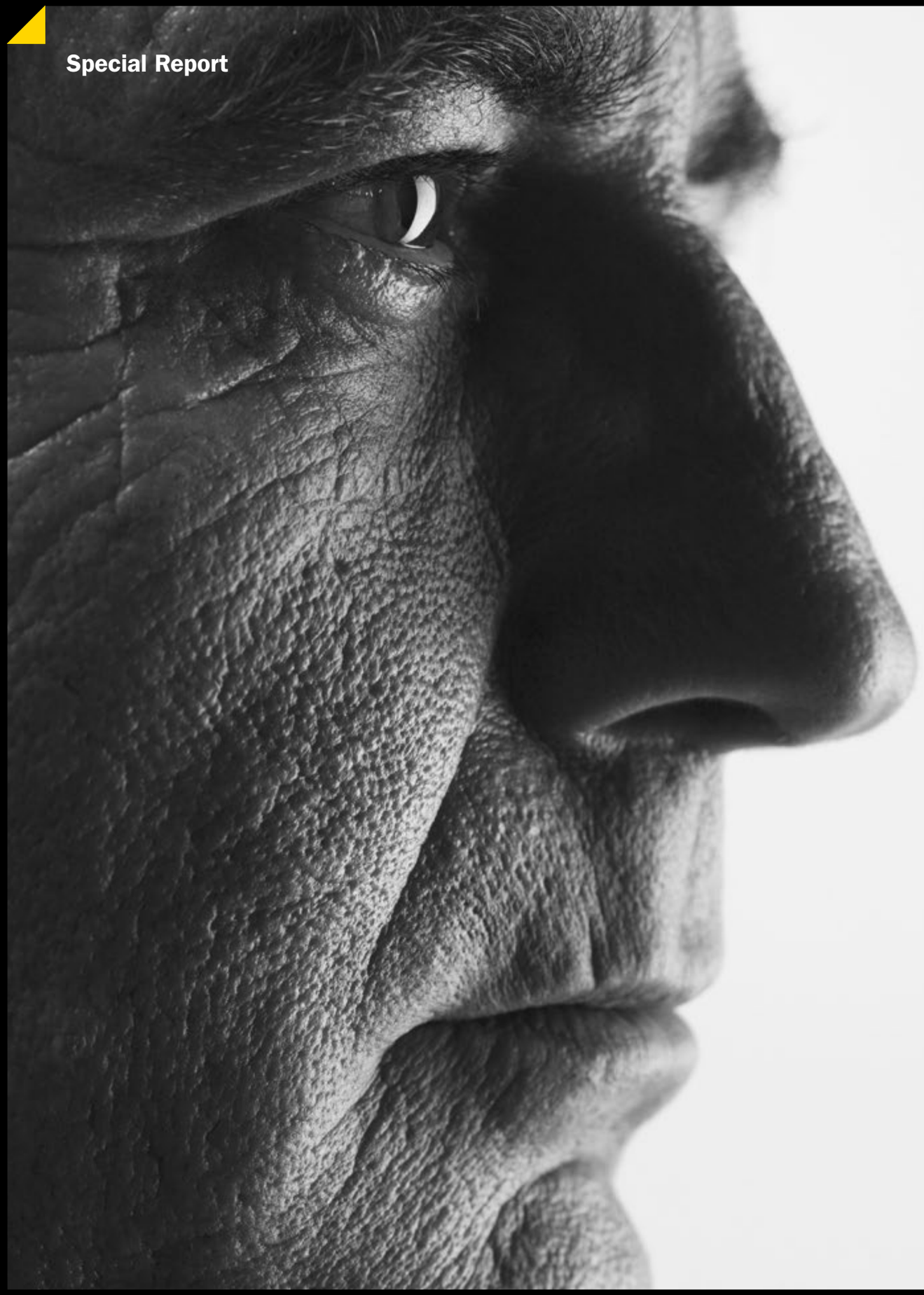
## BRIEFLY EXPLAINED: CONSCIOUSNESS

**Consciousness is generally understood** to mean that an individual not only has an idea, recollection or perception but also knows that he or she has it. For perception, this knowledge encompasses both the experience of the outer world ("it's raining") and one's internal state ("I'm angry"). Experts do not know how human consciousness arises. Nevertheless, they generally agree on how to define various aspects of it. Thus, they distinguish "phenomenal consciousness" (the distinctive feeling when we perceive, for example, that an object is red) and "access consciousness" (when we can report on a mental state and use it in decision-making).

Important characteristics of consciousness include subjectivity (the sense that the mental event belongs to me), continuity (it appears unbroken) and intentionality (it is directed at an object). According to a popular scheme of consciousness known as Global Workspace Theory, a mental state or event is conscious if a person can bring it to mind to carry out such functions as decision-making or remembering, although how such accessing occurs is not precisely understood. Investigators assume that consciousness is not the product of a single region of the brain but of larger neural networks. Some theoreticians go so far as to posit that it is not even the product of an individual brain. For example, philosopher Alva Noë of the University of California, Berkeley, holds that consciousness is not the work of a single organ but is more like a dance: a pattern of meaning that emerges *between* brains. *–S.A.*



# The Brain's Autopilot Mechanism Steers Consciousness

**Freud's notion of a dark, libidinous unconscious is obsolete. A new theory holds that the brain produces a continuous stream of unconscious predictions**

*By Steve Ayan*

STEWART SUTTON *GETTY IMAGES*

**Steve Ayan** is a psychologist and an editor at *Gehirn&Geist*.

IN 1909 FIVE MEN CONVERGED ON CLARK UNIVERSITY IN MASSACHUSETTS TO conquer the New World with an idea. At the head of this little troupe was psychoanalyst Sigmund Freud. Ten years earlier Freud had introduced a new treatment for what was called "hysteria" in his book *The Interpretation of Dreams*. This work also introduced a scandalous view of the human psyche: underneath the surface of consciousness roils a largely inaccessible cauldron of deeply rooted drives, especially of sexual energy (the libido). These drives, held in check by socially inculcated morality, vent themselves in slips of the tongue, dreams and neuroses. The slips in turn provide evidence of the unconscious mind.

At the invitation of psychologist G. Stanley Hall, Freud delivered five lectures at Clark. In the audience was philosopher William James, who had traveled from Harvard University to meet Freud. It is said that, as James departed, he told Freud, "The future of psychology belongs to your work." And he was right.

The view that human beings are driven by dark emotional forces over which they have little or no control remains widespread. In this conception, the urgings of the conscious mind constantly battle the secret desires of the unconscious. Just how rooted the idea of a dark unconscious has become in popular culture can be seen in the 2015 Pixar film *Inside Out*. Here the unconscious mind of a girl named Riley is filled with troublemakers and fears and housed in a closed space. People like to think of the unconscious as a place where we can shove uncomfortable thoughts and impulses because we want to believe that conscious thought directs our actions; if it did not, we would seemingly have no control over our lives.

This image could hardly be less accurate, however. Recent research indicates that conscious and unconscious processes do not usually operate in opposition. They are not competitors wrestling for hegemony over our psyche. They are not even separate spheres, as Freud's later classification into the ego, id and superego would suggest. Rather there is only *one* mind in which conscious and unconscious strands are interwoven. In fact, even our most reasonable thoughts and actions mainly result from automatic, unconscious processes.

## THE PREDICTIVE MIND

A revolutionary, and now widely accepted, counter-model to Freud's scheme goes by the term "predictive mind." The theory comes in different flavors, but overall it holds that automatic processes play a central role in the mind, allowing us to predict events quickly and accurately as they arise. Learning, experience and consciousness constantly improve our implicit, or unconscious, predictions, and we take note of events only when the predictions fail. That is, we become conscious of circumstances when they merit our attention. This automaticity enables us to function smoothly in the world, and becoming conscious when predictions fail enables us to avoid the pitfalls of automatic processing and adjust to changes in our environment. In a simplified example, unconscious processes predict the trajectory of a ball tossed to us and

### IN BRIEF

**Research** on the unconscious mind has shown that the brain makes judgments and decisions quickly and automatically. It continuously makes predictions about future events.

**According to the theory** of the "predictive mind," consciousness arises only when the brain's implicit expectations fail to materialize.

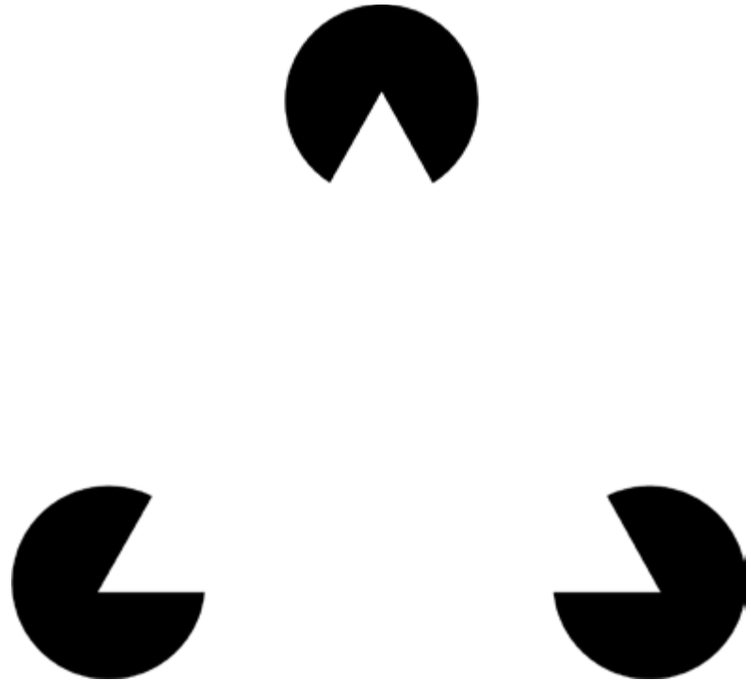
**Higher cognitive processing** in the cerebral cortex can occur without consciousness. The regions of the brain responsible for the emotions and motives, not the cortex, direct our conscious attention.

adjusts our limb motions accordingly. Conscious processing would become engaged, however, if the ball took a sudden right-angle turn.

Like the popular conception of the embattled mind, the predictive mind perspective is rooted in 19th-century precursors. Physicist and physiologist Hermann von Helmholtz was the first to hypothesize that the conclusions we arrive at automatically are anchored in perception. Our visual system, for example, readily produces an imaginary triangle out of three strategically placed circles with slices cut out (*illustration*). According to Helmholtz, such useful illusions proved that preprogrammed mechanisms shape our image of the world without our doing anything at all. The predictive mind model now hypothesizes that this automaticity shapes not only our perceptions but all mental processes, including our judgments, decisions and actions.

To physically function smoothly in the world, you need your brain to quickly and automatically distinguish between the body's own actions and external inputs. It accomplishes this feat by creating a so-called efference copy of each command it sends to muscles. When you shake your head back and forth, for example, you know that the external world is not rocking back and forth even though the visual cues reaching the brain might give that impression, because the efference copy indicates that the brain itself gave the motion commands. The efference copy is also the reason you cannot create the same tickle sensation in your own foot that others can induce: when the tickling sensation at the sole of your foot is processed, the areas of the brain responsible for perception of touch are already well informed that your own fingers are doing the job.

The workings of unconscious processes are also evident in a wide variety of other phenomena, such as automatic movements, spontaneous associations, jumping to instant conclusions (an example of what scientists call "implicit inferences") and perception of subliminal stimuli (those not consciously recognized). Laboratory experiments have shown that test subjects recognize the rule underlying a particular task before they are able to verbalize the rule. In one study design, for example, volunteers are asked to draw cards from two stacks, one that could bring huge hypothetical profits but also massive losses and one that is less risky; the volunteers are not told of the difference between the stacks. Signs of stress, such as increased sweating, will reveal that the subjects sense the pattern—the difference between the stacks—long before they can articulate that one of the piles is risky. As neuroscientist Nicolas Schuck of the Max Planck Institute for Human Development in Berlin has recently demonstrated, such implicit inferences affect activity in certain parts of the frontal lobe—where decisions are often said to be made—even before the test subjects make their decisions.



The Kanizsa triangle illusion provides evidence that our perception is based on implicit inferences. Our visual system constructs an imaginary triangle as a way to "explain" the arrangement of the circles.

### THE POWER OF SUBLIMINAL STIMULI

Research using a subliminal intervention called priming provides further examples of the ways unconscious processing influences behavior. Experimenters present images, words or even physical sensations in such a way that test subjects either will not notice the stimuli (because the exposure is too brief) or will disregard them (because they presumably have nothing to do with whatever is being focused on). In an example of the latter strategy, psychologists may ask subjects to read texts in which certain words appear multiple times without the words being highlighted and ask control subjects to read a neutral text. If the test subjects display measurable differences in thinking, feeling or acting after reading the text with multiple occurrences of the word, researchers can assume that the text had an unconscious effect.

Numerous studies have demonstrated that subliminal stimulation involving concepts such as aging or death have measurable consequences on behavior. Test subjects move more slowly, for example, or become more responsive to spiritual ideas. The phenomenon is familiar in everyday life. Passing a bakery, people may suddenly remember that they forgot to get the ingredients for a birthday cake. Our unconscious paves the way for our actions.

Such examples confirm that the brain functions

along multiple tracks. Compared with a computer, our gray matter chugs along very slowly—but on many parallel levels. Researchers often distinguish between two general strands, however. Nobel laureate in economics Daniel Kahneman calls them System 1 and System 2. Others speak of implicit and explicit or hot versus cold processing. The first strand (System 1, implicit, hot) refers to the rapid, automatic and uncontrollable workings of the unconscious mind; the other strand (System 2, explicit, cold) describes the slow, more flexible conscious processes that are subject to volition. But what is key in the predictive mind conception of mental functioning is that these two strands always work in tandem; in other words, our mind operates both unconsciously and consciously.

The following sentences illustrate the truth of this assertion: *Veery nmoral sopern acn dpeciher eseth drows. Talhoguh het telters rae ramscbled, ouy houlsd vahe on ficudiflty unstanddering thaw si geibn dias. Ouy anc od hist ecabuse fo het sursingpri mautoaticity fo het brian!* Most people will take only a fraction of a second to become aware of what the next word must be. The autopilot in our brain anticipates the words and quickly sorts the scrambled letters.

A big riddle is what precisely distinguishes conscious from unconscious processes at the neurophysiological level—and how exactly they interact. According to philosopher Peter Carruthers of the University of Maryland, College Park, we are aware only of the material in our working memory: the "user interface," so to speak. But working memory holds only a vanishingly small fraction of the data we take in. We remain unconscious of most of the input that floods the brain—and feeds System 1, which processes it automatically and quickly.

In 1909 a delegation of psychoanalysts, including Sigmund Freud (*bottom row, left*) and Carl Gustav Jung (*bottom row, right*), attended a conference at Clark University in Worcester, Mass., organized by Stanley Hall (*bottom row, center*). Freud delivered five lectures.

What does the brain do with these data? It constantly peers into the future, considering, What will happen next? What stimuli are likely to come up? Anything dangerous on the horizon? What are others up to? Such prognostications relate not only to the outer world but to the internal milieu of our bodies. Seen in this light, our desire to eat is nothing more than the unconscious anticipation of an impending loss of energy. Our unconscious aims to maintain homeostasis, to keep our body (including the balance of energy intake and use) in a steady state.

## PREDICTIVE NEUROBIOLOGY

Mark Solms of the University of Cape Town in South Africa, who is a strong proponent of the predictive mind theory, has added other insights to the neurobiological basis of unconscious and conscious functioning. In contrast to Freud, he argues that our mind is not seeking *greater* consciousness but rather the opposite—

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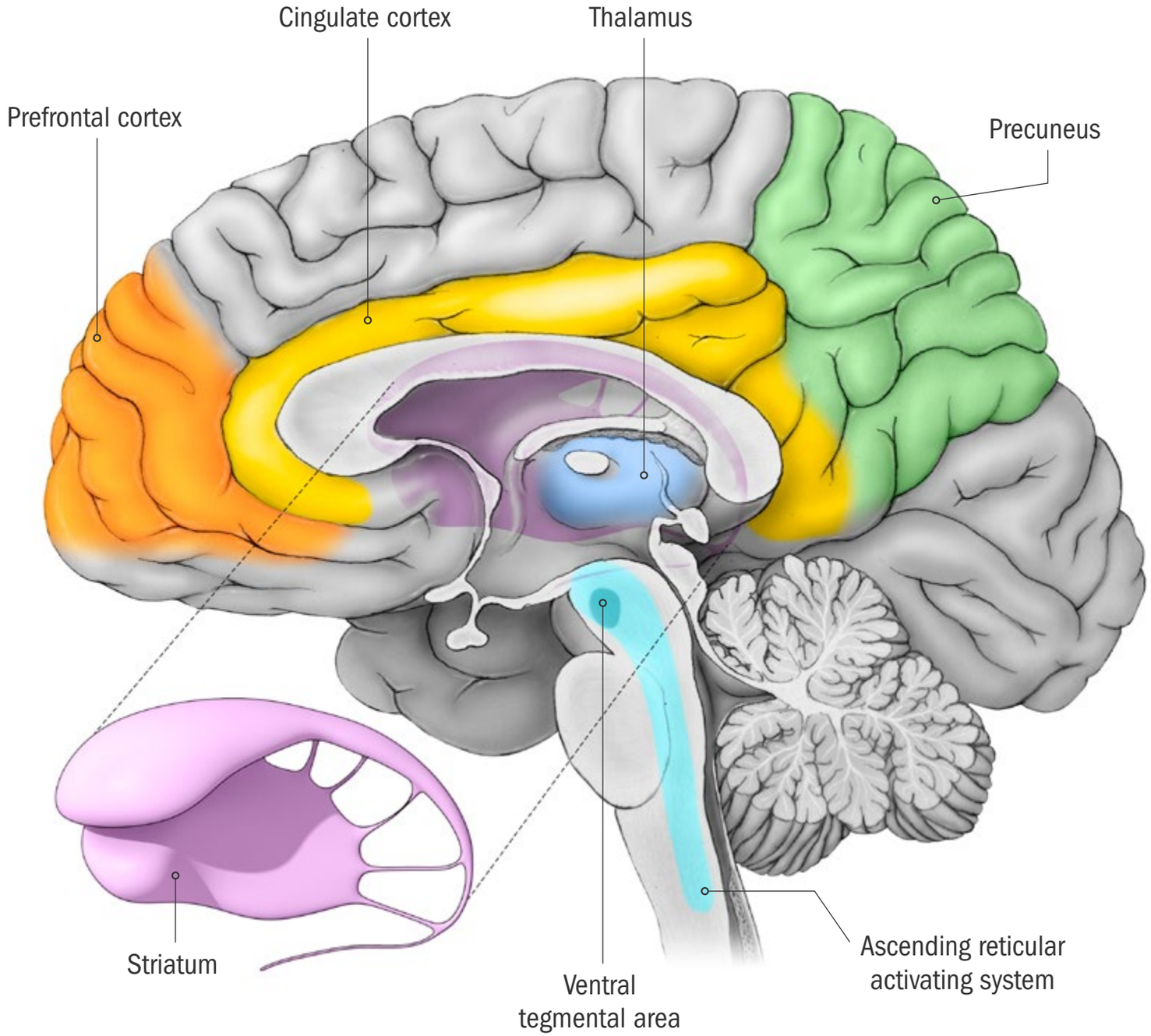
to keep consciousness to a minimum. As he explains, "You know the Talking Heads song where 'heaven is a place where nothing, nothing ever happens'? Well, that's the brain's preferred state because it is energy- and time-efficient. It's a survival mechanism."

Solms described this idea in a 2018 paper co-authored with Karl Friston of University College London, a key figure in the development of the imaging techniques that have so revolutionized brain research. About 10 years ago Friston introduced the free energy principle, a mathematically formalized version of the theory of the predictive brain. In his definition, free energy in the brain describes the neuronal state that results from the brain's failure to make a correct prediction; the brain does all it can to avoid free energy. In the final analysis, Solms and Friston assert, predictive errors equal surprise equals consciousness; when things do not work as expected, we get consciousness—a state the brain tries to limit.

This perspective not only stands Freud's theory on its head, but it also contradicts the classic view that the cortex (the outer layer of the cerebrum) is the source of consciousness. According to Solms, these higher regions are not the bearers of consciousness but instead are "told" what to attend to by deeper structures in the brain stem and midbrain. Solms locates the source of consciousness in the areas of the brain that regulate alertness, emotional stimulation, and drives—precisely those areas where Freud located the unconscious (*brain illustration*). "The pattern-detection mechanisms of the cortex work most efficiently without conscious attention. It is the deeper, emotional parts of the brain, the limbic structures, from which consciousness arises," he says.




The brain's outer rind—the cerebral cortex—is the seat of higher mental functions in traditional views of the brain. But in a model proposed by Mark Solms of the University of Cape Town in South Africa, consciousness arises from activity in lower regions, such as the reticular activating system, the ventral tegmentum and the thalamus. For instance, sensory information—all of which passes through the thalamus—becomes conscious only when it is emotionally or motivationally relevant, in which case the prefrontal and the cingulate cortex direct our attention to it. Meanwhile the striatum and the precuneus play a role in automatic movement control and orientation, which enable us to interact with our environment without giving it a conscious thought.

FALCONIERI VISUALS

This hypothesis can be empirically confirmed. Children who as a result of developmental disorders were born without a cerebral cortex are capable of forms of consciousness, for example. Such infants, if they survive into childhood, are not only alert but display emotional reactions. In a 2007 review, neuroscientist Björn Merker concluded that numerous conscious phenomena occur even without a cerebral cortex. Although more complex mental operations such as logical thinking or self-reflection are not possible, emotions such as joy, annoyance or sadness can be experienced.

## THE REAL MASTERMIND

Many people stubbornly cling to the old distinction between the instinctive unconscious and rational consciousness, with a preference for the latter. But, as I have shown, this view is untenable. Unconscious processes greatly control our consciousness. Where you direct your attention, what you remember and the ideas you have, what you filter out from the flood of stimuli that bombard you, how you interpret them and what goals you pursue—all these result from automatic processes. Timothy Wilson of the University of Virginia considers this reliance on the unconscious to be the price that we pay for survival as a species. If we were forced always to consider every aspect of the situation around us and had to weigh all our options about what to do, humankind would have died out long ago. The autopilot in our brain—not consciousness—makes us what we are.

The real mastermind that solves problems and ensures our survival, then, is the unconscious. It is understandable that people tend to distrust the unconscious, given that it seems uncontrollable. How are we supposed to be in control of something when we do not even know when and how it influences us? Nevertheless, the arrangement works.

John Bargh of Yale University, who studies priming, compares the human mind to a sailor: To steer a boat from point A to point B, a sailor needs to know the destination and be able to make course corrections. Such abilities are not sufficient, however, because, as is true of the unconscious, uncontrollable factors such as ocean currents and wind come into play. But expert sailors take them into account to arrive at their destination.

We do well to treat our unconscious similarly—by not getting in its way. And that is really what we do day in and day out. When I put a picture of my loved ones on my desk to fuel my motivation for work or when I take the stairs instead of the elevator, I am steering my unconscious mind, recognizing that its desires for leisure and rest do not serve my best interests at the moment. And the fact that I am able to do this shows that the conscious and the unconscious are partners rather than opponents. **M**

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## MORE TO EXPLORE

**Consciousness without a Cerebral Cortex: A Challenge for Neuroscience and Medicine**. Bjorn Merker in *Behavioral and Brain Sciences*, Vol. 30, No.1, pages 63–81; February 2007.
**Medial Prefrontal Cortex Predicts Internally Driven Strategy Shifts**. Nicolas W. Schuck et al. in *Neuron*, Vol. 86, No. 1, pages 331–340; April 8, 2015.
**Surfing Uncertainty: Prediction, Action, and the Embodied Mind**. Andy Clark. Oxford University Press, 2015.
**How and Why Consciousness Arises: Some Considerations from Physics and Physiology**. Mark Solms and Karl Friston in *Journal of Consciousness Studies*, Vol. 25, Nos. 5–6, pages 202–238; May/June 2018.

# The Hippies Were Right: It's All about Vibrations, Man!

## A new theory of consciousness

*By Tam Hunt*

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**Tam Hunt** is a practicing lawyer (renewable energy law and policy) by day and by night a scholar (affiliated with the University of California, Santa Barbara's department of brain and cognitive sciences) in the philosophy of mind, the philosophy of biology and the philosophy of physics.

# Why are some things conscious and others apparently not? Is a rat conscious? A bat? A cockroach? A bacterium? An electron?

These questions are all aspects of the ancient "mind-body problem," which has resisted a generally satisfying conclusion for thousands of years.

The mind-body problem enjoyed a major rebranding over the last two decades and is generally known now as the "hard problem" of consciousness (usually capitalized nowadays), after the New York University philosopher David Chalmers coined this term in a now classic 1995 paper and his 1996 book *The Conscious Mind: In Search of a Fundamental Theory*.

Fast forward to the present era and we can ask ourselves now: Did the hippies actually solve this problem? My colleague, Jonathan Schooler of the University of California, Santa Barbara, and I think they effectively did, with the radical intuition that it's all about vibrations ... man. Over the past decade, we have developed a "resonance theory of consciousness" that suggests that resonance—another word for synchronized vibrations—is at the heart of not only human consciousness but of physical reality more generally.

So how were the hippies right? Well, we agree that vibrations, resonance, are the key mechanism behind human consciousness, as well as animal consciousness more generally. And, as I'll discuss below, that they are the basic mechanism for all physical interactions to occur.

All things in our universe are constantly in motion, vibrating. Even objects that appear to be stationary are in fact vibrating, oscillating, resonating, at various frequencies. Resonance is a type of motion, characterized by oscillation between two states. And ultimately all matter is just vibrations of various underlying fields.

An interesting phenomenon occurs when different vibrating things/processes come into proximity: they will often start, after a little time, to vibrate together at the same frequency. They "sync up," sometimes in ways that can seem mysterious. This is described today as the phenomenon of spontaneous self-organization.

Examining this phenomenon leads to potentially deep insights about the nature of consciousness and about the universe more generally.

## ALL THINGS RESONATE AT CERTAIN FREQUENCIES

Stephen Strogatz provides various examples from physics, biology, chemistry and neuroscience to illustrate what he calls "sync" (synchrony) in his 2003 book also called *Sync*, including:

- Fireflies of certain species start flashing their little fires in sync in large gatherings of fireflies, in ways that can be difficult to explain under traditional approaches.
- Large-scale neuron firing can occur in human brains at specific frequencies, with mammalian consciousness thought to be commonly associated with various kinds of neuronal synchrony.
- Lasers are produced when photons of the same power and frequency are emitted together.
- The moon's rotation is exactly synced with its orbit around Earth such that we always see the same face.

Resonance is a truly universal phenomenon and at the heart of what can sometimes seem like mysterious tendencies toward self-organization.

Pascal Fries, a German neurophysiologist with the Ernst Strüngmann Institute, has explored in his high-

ly cited work over the last two decades the ways in which various electrical patterns, specifically, gamma, theta and beta waves, work together in the brain to produce the various types of human consciousness.

These names refer to the speed of electrical oscillations in the various brain regions, as measured by electrodes placed on the outside of the skull. Gamma waves are typically defined as about 30 to 90 cycles per second (hertz), theta as a 4- to 7-HZ rhythm, and beta as 12.5 to 30 HZ. These aren't hard cutoffs—they're rules of thumb—and they vary somewhat in different species.

So, theta and beta are significantly slower than gamma waves. But the three work together to produce, or at least facilitate (the exact relationship between electrical brain patterns and consciousness is still very much up for debate), various types of human consciousness.

Fries calls his concept "communication through coherence" or CTC. For Fries it's all about neuronal synchronization. Synchronization, in terms of shared electrical oscillation rates, allows for smooth communication between neurons and groups of neurons. Without coherence (synchronization), inputs arrive at random phases of the neuron excitability cycle and are ineffective, or at least much less effective, in communication.

Our resonance theory of consciousness builds upon the work of Fries and many others, in a broader approach that can help to explain not only human and mammalian consciousness, but also consciousness more broadly. We also speculate metaphysically about the nature of consciousness as a more general phenomenon of all matter.

## ARE ALL THINGS AT LEAST A LITTLE BIT CONSCIOUS?

Based on the observed behavior of the entities that surround us, from electrons to atoms to molecules to bacteria to paramecia to mice, bats, rats, etc., all things may be viewed as at least a little conscious. This sounds strange at first blush, but "panpsychism"—the view that all matter has some associated consciousness—is an increasingly accepted position with respect to the nature of consciousness.

The panpsychist argues that consciousness (subjectivity) did not emerge; rather, it's always associated with matter, and vice versa (they are two sides of the same coin), but mind as associated with most of the matter in our universe is generally very simple. An electron or an atom, for example, enjoys just a tiny amount of consciousness. But as matter "complexifies," so mind complexifies, and vice versa.

Biological organisms have leveraged faster information exchange through various biophysical pathways, including electrical and electrochemical pathways. These faster information flows allow for more macro-scale levels of consciousness than would occur in similar-scale structures like boulders or a pile of sand, simply because there is significantly greater connectivity and thus more "going on" in biological structures than in a boulder or a pile of sand. Boulders and piles of sand only have thermal pathways with very limited bandwidth.

Boulders and piles of sand are "mere aggregates" or just collections of more rudimentary conscious entities (probably at the atomic or molecular level only), rather than combinations of micro-conscious entities that combine into a higher level macro-conscious entity, which is the hallmark of biological life.

Accordingly, the type of communication between resonating structures is key for consciousness to expand beyond the rudimentary *type* of consciousness that we expect to occur in more basic physical structures.

The central thesis of our approach is this: the particular linkages that allow for macro-consciousness to occur result from a shared resonance among many micro-conscious constituents. The speed of the resonant waves that are present is the limiting factor that determines the size of each conscious entity.

As a shared resonance expands to more and more constituents, the particular conscious entity grows larger and more complex. So, the shared resonance in a human brain that achieves gamma synchrony, for example, includes a far larger number of neurons and neuronal connections than is the case for beta or theta rhythms alone.

It's resonating structures all the way down—and up.

Our resonance theory of consciousness attempts to provide a unified framework that includes neuroscience and the study of human consciousness, but also more fundamental questions of neurobiology and biophysics. It gets to the heart of the differences that matter when it comes to consciousness and the evolution of physical systems.

It is all about vibrations, but it's also about the type of vibrations and, most important, about shared vibrations.

Put that in your pipe and smoke it … man. **M**

A German family poses for a portrait, 1937.

# Harsh Nazi Parenting Guidelines May Still Affect German Children of Today

**The Nazi regime urged German mothers to ignore their toddlers' emotional needs—the better to raise hardened soldiers and followers. Attachment researchers say that the harmful effects of that teaching may be affecting later generations**

*By Anne Kratzer*

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**Anne Kratzer** is a psychologist and journalist in Heidelberg, Germany. When she told her mother about her work on this article, her mother went up to the attic and returned with one of Johanna Haarer's books, which she had never trusted.

RENATE FLENS, A GERMAN WOMAN IN HER 60S WHO SUFFERS FROM depression, tells her psychotherapist that she wants to love her children but just can't. She and the therapist soon realize that both Flens's problems may be rooted in her frustration at being unable to allow others to get close to her. After lengthy conversations, they realize something else: a contributing factor may well be the child-rearing teachings of Johanna Haarer, a physician whose books were written during the Nazi era and aimed at raising children to serve the Führer. Flens (a pseudonym) was born after World War II, but Haarer's books were still popular during her postwar childhood, where many households had a copy of *The German Mother and Her First Child*—a book that continued to be published for decades (ultimately cleansed of the most objectionable Nazi language). When asked, Flens recalled seeing one of Haarer's books on her parents' bookshelf.

Flens's story, told to me by her therapist, illustrates an issue troubling a number of mental health experts in Germany: Haarer's ideas may still be harming the emotional health of its citizens. One aspect was particularly pernicious: she urged mothers to ignore their babies' emotional needs. Infants are hardwired to build an attachment with a primary care giver. The Nazis wanted children who were tough, unemotional and unempathetic and who had weak attachments to others, and they understood that withholding affection would support that goal. If an entire generation is brought up to avoid creating bonds with others, the experts ask, how can members of that generation avoid replicating that tendency in their own children and grandchildren?

"This has long been a question among analysts and attachment researchers but ignored by the general public," says Klaus Grossmann, a leading researcher in mother-child attachment, now retired from the University of Regensburg. The evidence that Haarer's teachings are still affecting people today is not definitive. Nevertheless, it is supported by studies of mother-child interactions in Germany, by other research into attachment and by therapists' anecdotal reports.

## HAARER'S TEACHINGS

Haarer was a pulmonologist, who, despite having no pediatric training, was touted as a child-rearing expert by the Nazis (the National Socialists). The recommendations from her book, originally published in 1934, were incorporated into a Reich mothers training program designed to inculcate in all German women the proper rules of infant care. As of April 1943, at least three million German women had gone through this program. In addition, the book was accorded nearly biblical status in nursery schools and child-care centers.

Although children need sensitive physical and emotional contact to build attachments and thrive, Haarer recommended that such care be kept to a minimum, even when carrying a child. This stance is clearly illustrated in the pictures in her books: mothers hold their children so as to have as little contact as possible.

Haarer viewed children, especially babies, as nuisances whose wills needed to be broken. "The child is to be fed, bathed, and dried off; apart from that left completely alone," she counseled. She recommended that children be isolated for 24 hours after the birth; instead of using "insipid-distorted 'children's language,'" the mother should speak to her child only in "sensible German"; and if the child cries, let him cry.

Sleep time was no exception. In *The German Mother and Her First Child*, Haarer wrote, "It is best if the child is in his own room, where he can be left alone." If the child starts to cry, it is best to ignore him: "Whatever you do, do not pick the child up from his bed, carry him around, cradle him, stroke him, hold him on your lap, or even nurse him." Otherwise, "the child will quickly understand that all he needs to do is cry in order to attract a sympathetic soul and become the object of caring. Within a short time, he will demand this service as a right, leave you no peace until he is carried again, cradled, or stroked—and with that a tiny but implacable house tyrant is formed!"

Before publishing *The German Mother and Her First Child*, which ended up selling 1.2 million copies, Haarer had written articles about infant care. Later titles included *Mother, Tell Me about Adolf Hitler!*, a fairy-tale-style book that propagated anti-Semitism and anti-Communism in language a child could understand, and another child-rearing manual, *Our Little Children*. Haarer was imprisoned for a time after Germany's defeat in 1945 and lost her license to practice medicine. According to two of her daughters, she nonetheless remained an enthusiastic Nazi. She died in 1988.

## MODERN CONSEQUENCES

There are many reasons to think that Haarer's influence persisted long after the war and continues to affect the emotional health of Germans today even though parents no longer rely on her books. Researchers, physicians and psychologists speculate that attachment and emotional deficits may contribute to an array of phenomena of modern life, including the low birth rate, the many people who live alone or are separated, and the widespread phenomena of burnout, depression and emotional illnesses in general. Of course, the causes of these personal and societal issues are many and varied. But the stories of people such as Renate Flens lend credence to the idea that Haarer's lessons could play a role.

As Flens's therapist notes, after a time patients may disclose their disgust at their own body and admit to following strict eating rules or to being unable to enter into close relationships—which are all consistent with the outcome of Haarer's child-rearing regimen. Psychotherapist Hartmut Radebold, formerly of the University of Kassel, tells of a patient who came to him with serious relational and identity problems. One day this man found a thick book at home in which his mother had noted all kinds of information about his first year of life: weight, height, frequency of bowel movements—but not a single word about feelings.

In the laboratory, Grossman, who retired in 2003, continually observed scenes such as this: A baby cries. The mother rushes over toward him but stops in her tracks before reaching him. Although she is only a few feet from her child, she makes no effort to pick him up or console him. "When we asked the mothers why they did this, they invariably stated that they didn't want to spoil their babies."

That sentiment, along with sayings like "An Indian feels no pain"—an idiom essentially meaning "Be as stoic as a Native American"—continued to be widespread in postwar Germany and is still heard today.

## RESEARCH REVEALS HARM

Haarer's recommendations were viewed as modern in the Nazi era and promulgated as if scientifically sound. Studies have since demonstrated that Haarer's advice is indeed traumatizing.

Ilka Quindeau of the Frankfurt University of Applied Sciences and her colleagues have studied the generation of children born during the war. They initially intended to examine the long-term effects of bombing raids and flight under perilous circumstances. But after the initial interviews, the researchers decided to adjust the study design: so many of their conversations revolved around experiences in the family that the team added a lengthy interview that focused exclusively on those interactions. Ultimately, the investigators concluded that many interviewees exhibited a pattern of unusually strong loyalty toward their parents and that their failure to include mention of conflicts in their descriptions was evidence of "a relational disorder."

Quindeau has pointed out that Germany is the only country in Europe where what happened to the children of war has been so broadly discussed, despite destruction and bombings having occurred in other countries as well. She has also noted that psychoanalyst Anna Freud found that children with a healthy attachment to their parents were less traumatized by the war than those with a less solid attachment. Putting everything together, Quindeau concludes that the interviews she conducted about bombings and exile had actually uncovered something more than the effects of war: they revealed deep grieving about experiences in the family that were so traumatic they

### IN BRIEF

**In 1934** physician Johanna Haarer published *The German Mother and Her First Child*. Her advice guided child-rearing in the Third Reich. It ultimately sold some 1.2 million copies, almost half of them after the end of the war.

**In that book,** Haarer recommended that children be raised with as few attachments as possible. If a child cried, that was not the mother's problem. Excessive tenderness was to be avoided at all cost.

**Psychotherapists** fear that this kind of upbringing led many children in Germany to develop attachment difficulties and that those problems might have been passed on to subsequent generations.

could not be expressed directly.

Direct evidence for Quindeau's interpretation is hard to come by, however: randomized, controlled experimental studies that examine Haarer's educational recommendations cannot be conducted for ethical reasons; the probability of doing harm is just too great. Nevertheless, even research that does not explicitly deal with child-rearing in the Third Reich can provide important information, Grossmann says. "All the data we have tell us that if we deny a child sensitive caring during the first one or two years of life, as Johanna Haarer suggests," you end up with children who have limited emotional and reflective abilities.

Some of the evidence, Grossmann says, comes from a longitudinal study in which 136 Romanian orphans between the ages of six and 31 months were divided into two groups: half remained in the orphanage; the rest were taken in by foster parents. A control group consisted of children from the region who had always lived with their natural parents. Both the children who remained in the orphanage and those who were fostered developed attachment problems. For example, in a 2014 experiment with 89 of the orphans, a stranger came to the door and, without giving a reason, told a child to follow him. Only 3.5 percent of the children in the control group obeyed, whereas 24.1 percent of the children in foster care followed the stranger, and 44.9 percent of the children living in the orphanage did.

"Children like this—who are easily seduced, don't think and don't feel—are fodder for a nation bent on war," says Karl Heinz Brisch, a psychiatrist at the Dr. von Hauner Children's Hospital at the Ludwig Maximilian University of Munich. "In Johanna Haarer's view, it is important to deny caring when a child asks for it. But each refusal means rejection," Grossmann explains. The only means of communication open to a newborn are facial expression and gestures, he adds. If no response is forthcoming, children learn that nothing they try to communicate means anything. Moreover, infants experience existential fear when they are alone and hungry and receive no comfort from their attachment figure. In the worst case, such experiences lead to a form of insecure attachment that makes it difficult to enter into relationships with other people in later life.

**"Whatever you do, do not pick the child up from his bed, carry him around, cradle him, stroke him, hold him on your lap, or even nurse him." Otherwise, "the child will quickly understand that all he needs to do is cry in order to attract a sympathetic soul and become the object of caring."**
***—Johanna Haarer***

### WHY MOTHERS TOOK THE ADVICE

Why did so many mothers follow Haarer's counterintuitive advice? Radebold, whose research has focused on the generation of children born during the war, notes that Haarer's views on child-rearing did not appeal to everyone during the 1930s and 1940s but attracted two groups in particular: parents who identified strongly with the Nazi regime and young women who had themselves come from emotionally damaged families (largely as a result of World War I), who had no idea what a good relationship feels like. If, in addition, their husbands were fighting at the front—leaving them to fend for themselves and to feel overburdened and insecure—it may well be imagined that the toughness promoted in Haarer's books could have been appealing.

Of course, strict child-rearing practices had been commonplace in Prussia well before the Nazis came on the scene. In Grossmann's opinion, only a culture that already had a tendency for hardness would have been ready to institute such practices on a grand scale. Studies on attachment conducted in the 1970s are consistent with this view. He notes, for example, that in Bielefeld, which is in northern Germany, half of all children were shown to exhibit an insecure attachment; in Regensburg, which is in southern Germany and never came under Prussian influence, less than a third fit that category.

To evaluate how secure the attachment is between a child and a parent, Grossmann and other attachment researchers often use the Strange Situation test, which was developed by psychologist Mary Ainsworth while at Johns Hopkins University in the 1960s. In one version, a parent and toddler enter a room, and the child is placed near some toys. After about 30 seconds the parent sits down in a chair and begins to read a newspaper or magazine. After at most two minutes, the parent is signaled to encourage the child to play. A few minutes later a strange woman enters the room. Initially silent, she begins to talk to the parent and then tries to engage with the child. Shortly thereafter the parent gets up and leaves the room. After a brief period, the parent returns, and the strange person leaves. A few moments later the parent again exits the room, leaving the child behind. After a few minutes the strange woman reenters the room and begins to engage with the child, and then the

parent returns as well.

Attachment researchers closely observe the child's behavior during the entire episode. If the child is upset for a while and cries during the separation but soon calms down, he or she is viewed as securely attached. Children who cannot calm themselves—or who never react to the disappearance of their attachment figure—are assessed as insecurely attached. Grossmann has conducted this test in a number of different cultures. He found that in Germany, in contrast to other Western countries, many parents view it as positive when their children do not respond to their disappearance. The parents perceive this reaction as "independence."

## LIKE PARENT, LIKE CHILD

Grossmann's findings also indicate that when children grow up and begin to have children themselves, they pass their attachment behavior down to the next generation. As part of one of his studies, he and his colleagues used interviews to examine the quality of the attachment that parents had in their own childhood, conducting the study about five years after giving the Strange Situation test to the subjects' children. In assessing the parents' responses, the researchers looked not only at what the adults were saying but also at the emotions they exhibited during the interview. For example, they observed whether the parents switched the subject frequently, gave only monosyllabic answers or indulged in overgeneralized praise of their own parents without describing actual situations. The results showed that the attachment quality of the children often mirrored that of their parents. A 2016 meta-analysis published by Marije Verhage of VU University Amsterdam and her colleagues, which analyzed data from 4,819 individuals, confirmed that the quality of attachment is transmitted from generation to generation.

How exactly the negative childhood experiences of parents are transmitted to their own children is still a matter of conjecture. But biological processes appear to be involved. In 2007, for example, Dahlia Ben-Dat Fisher, then at Concordia University in Montreal, and her colleagues found that the children of mothers who had themselves been neglected in childhood regularly exhibited lower levels of the stress hormone cortisol in the morning. The researchers interpret this pattern as a sign of abnormal stress processing.

In 2016 a team led by Tobias Hecker, then at the University of Zurich, compared a group of children in Tanzania who reported having undergone a great deal of physical and mental abuse with children who reported little abuse. Those in the first group had more medical problems as well as an abnormal pattern of methylation (binding by the chemical group CH3) of the gene that codes for the protein proopiomelanocortin. This protein is a precursor for an array of hormones, among them the stress hormone adrenocorticotropin, produced in the pituitary gland. Altered DNA-methylation patterns can affect the amount of protein made from a gene, and this pattern can be passed on from generation to generation. Researchers have observed this phenomenon in animal experiments; in humans, the picture is as yet less clear.

Parents can grapple with their own attachment experiences and try to raise their own children differently. "But," Grossman says, "in stressful moments, we often fall back on learned, unconscious patterns." This tendency may be one reason that Haarer's youngest daughter, Gertrud, decided never to have children herself. In 2012 she publicly confronted her mother's legacy, writing a book about Johanna Haarer's life and ideas. Speaking about her own childhood in an interview on Bavarian television, Gertrud Haarer declared, "Apparently it so traumatized me that I thought I could never raise children." **M**

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# The Neuroscience of Creativity: Q&A with Anna Abraham

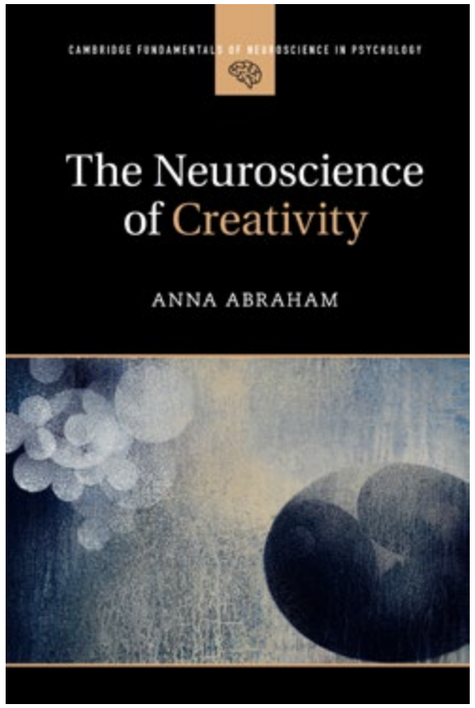
## The latest state of the field of the neuroscience of creativity

*By Scott Barry Kaufman*

ROGER HARRIS *GETTY IMAGES*

**Scott Barry Kaufman** is a psychologist, author and podcaster who is deeply interested in using psychological science to help all kinds of minds live a creative, fulfilling and meaningful life. Kaufman has over 60 scientific publications on intelligence, creativity, personality and well-being. In addition to writing the column Beautiful Minds for *Scientific American*, he also hosts The Psychology Podcast. He is also the author and editor of eight books. Kaufman received a Ph.D. in cognitive psychology from Yale University and an M. Phil. in experimental psychology from the University of Cambridge.

What is going on in our brains when we are creating? How does our brain look different when we are engaging in art versus science? How does the brain of genius creators differ from the rest of us? What are some of the limitations of studying the creative brain? The neuroscience of creativity is booming. There is now a society (with an annual conference), an edited volume, a handbook, and an entire textbook on the topic. Bringing the latest research together from a number of scientists, Anna Abraham wrote a wonderful resource that covers some of the most hot button topics in the field. She was gracious enough to do a Q&A with me. Enjoy!




**How did you get interested in the neuroscience of creativity?**

I have always been curious about creativity. At the most fundamental level I think I simply wanted to get my head around the mystery of this marvelous ability that each of us possesses. In particular, I hoped to find out what makes some people more creative than others. When I saw an opportunity to pursue a Ph.D. in neuroscience in the early 2000s in any topic of my choice, I went all in—it was an exciting and promising approach that had until then only been limitedly used to explore the creative mind.

**What is creativity? Does the field have a unified, agreed upon definition of creativity that you are satisfied with?**

There is a surprising level of unanimity in the field when it comes to a boilerplate definition. Most experts agree that two elements are central to creativity. First and foremost, it reflects our capacity to generate ideas that are original, unusual or novel in some way. The second element is that these ideas also need to be satisfying, appropriate or suited to the context in question. I am reasonably satisfied with this definition but not in how it guides scientific inquiry. Alone the fact that many of the empirical findings in relation to creativity that make the rounds are not in relation to originality—the core feature of creativity—but to associated factors like fluency and flexibility points to the disconnect that abounds in our scientific discourse.

**What are some of the challenges of defining creativity comprehensively?**

One of the central challenges is to have a definition that can be satisfactorily applied across all manifestations of creativity regardless of whether the "object" being judged is a work of art or a scientific theory or a public policy strategy (and so on). Another stems from the problem of inherent subjectivity when judging and classifying an "object" as one that is less or more creative. What yardstick am I using in such a context? And how similar is it to the one you are using? Do I have enough background knowledge or the necessary expertise as a judge to make that decision? Even if I did, how do the limits of what I know or how I think constrain my ability to recognize instances of creativity in others?

**Can creativity be measured?**

Some aspects of creativity can be measured—yes. The problem is we don't have nearly enough tools even for this purpose.

**Which creativity approach is best suited to the neuroscientific perspective?**
The influential four Ps conceptualization refers to the approaches that can be adopted in the study of creativity. Approaches focusing on factors that abet or thwart creativity may be external in that they are part of the environment (press/place) or internal in the form of traits and skills that typify the individual (person). These are distinct from approaching creativity in relation to the mental operations that transpire during creative ideation (process) and the outputs thereof (product). The neuroscientific perspective falls under the wider umbrella of the physiological approach, and I maintain that this constitutes the fifth "P" of creativity as it is an approach in its own right with its own methods of study and unique insights that it affords about creativity. The book I wrote is a testament to this view.

**What are some unique problems faced in the neuroscientific study of creativity that aren't faced in other complex aspects of human psychological function that lend themselves more easily to objective scientific inquiry?**
There are several. The most significant problem is that one cannot prompt creativity. For many rather complex functions, you can quite simply cue a response with an appropriate question. One can determine if a person remembers a particular event (what did you do on your last birthday?), knows a fact (how many rings does Saturn have?), experienced a stimulus (can you hear the police siren?), enjoys an experience (how much do you like cycling?), and so on. But, as many of us know through our own experience, we unfortunately cannot automatically elicit a cascade of creative thought with a mere prod. We may be trying to be creative when tasked to do so, but this is not the same as being creative.

**What's the difference between "brain-to-process" and "process-to-brain" explanation of creativity?**
The difference there lies in directions of exploration when uncovering the brain basis of creativity. If your starting point is a process that is of special relevance to creativity, such as improvisation, and you examine the brain correlates of the same, you will be undertaking a process-to-brain exploration. One can go the other way around as well—by starting at the level of a brain structure or brain activity pattern that is (or stands to be) of special relevance to creativity. Let's say we travel back in time and manage to get a hold of Mozart's brain postmortem. Upon examining it, we discover the habenular nuclei in Mozart's brain are atypical in some manner. We might see this as reason enough to hypothesize that Mozart's staggering proficiency in composition may have its roots in the atypicality of this neuroanatomical structure in his brain. This would be an example of the brain-to-process exploration, and it is one that has actually been adopted in the examination of Einstein's brain.

**Why does the myth of the "creative right brain" still persist? Is there any truth at all to this myth?**
Like most persistent myths, even if some seed of truth was associated with the initial development of the idea, the claim so stated amounts to a lazy generalization and is incorrect. The brain's right hemisphere is not a separate organ whose workings can be regarded in isolation from that of the left hemisphere in most human beings. It is also incorrect to conclude that the left brain is uncreative. In fact even the earliest scholars who explored the brain lateralization in relation to creativity emphasized the importance of both hemispheres. Indeed this is what was held to be unique about creativity compared to other highly lateralized psychological functions. In an era that saw the uncovering of the dominant involvement of one hemisphere over the other for many functions, and the left hemisphere received preeminent status for its crucial role in complex functions like language, a push against the tide by emphasizing the need to also recognize the importance of the right hemisphere for complex functions like creativity somehow got translated over time into the only "creative right brain" meme. It is the sort of thing that routinely happens when crafting accessible sound bites to convey scientific findings.

**What are some of the intricacies of frontal lobe function in relation to creativity?**
Trying to pin down the nature of frontal lobe function in relation to creativity often feels like holding on to a slippery fish. The first thing to bear in mind is that it is a massive heterogeneous structure covering about a third of the neocortex and that different parts of the frontal lobes are involved when we engage in creative ideation. Another feature of the frontal lobe function is that damage to different parts of this brain region results in some disadvantages in creative performance but also with specific advantages. For instance, damage to the dorsolateral prefrontal cortex has been associated with more success in insight problem-solving and lesions in frontopolar regions with a greater ability to overcome the constraints of salient examples when creating something new. Whether the advantages and disadvantages in creativity are rooted in which specific aspects of creative cognition are being examined, or in the location and extent of lesion site in the brain, or in the dynamics of implicated wider brain networks, are as yet unknown.

**What are the differing brain correlates of insight, analogy and metaphor cognitive processing?**
All these operations of creative cognition have overlap-

ping brain correlates, but what differs are the specific brain regions that are held to be of significance in each of these processes. The role of frontal poles is emphasized in the case of analogical reasoning, the lateral inferior frontal gyrus in metaphor processing, and anterior aspects of the superior temporal gyrus in insight. A clear affirmation of the particular relevance of these brain areas for each of these processes would be to examine all of them within one experimental paradigm.

**What happens in our brains when we operate in a creative mode versus an uncreative mode?**
So far we have only scratched the surface of this big question. What is obvious is that a lot about what triggers a creative mode as opposed to an uncreative mode is situational. The creative mode is called for in contexts that are unclear, vague and open-ended. The opposite is true of the uncreative mode. And so the uncreative mode involves walking firmly along the "path of least resistance" through the black-and-white zone of the expected, the obvious, the accurate or the efficient. Whereas the creative mode involves turning away from the path of least resistance and venturing into the briars so to speak in an effort to forge a new path through the gray zone of the unexpected, the vague, the misleading or the unknown. We know a great deal about the receptive-predictive cycle of the brain in place during the uncreative mode. We know a lot less about the explorative-generative cycle that is in place during the creative mode. But what we do know is fascinating. For instance, several large-scale brain networks that are known to operate in circumscribed ways in the uncreative mode are engaged in an integrative and dynamic manner during the creative mode. Examining creative thinking as a multifaceted construct has greatly improved our understanding of the roles of specific brain regions in specific aspects of creativity such as insight, imagery, analogical reasoning, overcoming knowledge constraints, conceptual expansion and so on. Among the most thought-provoking findings is our ability to engage in creative pursuits despite disorder and degeneration at the neural level. This attests to the disorder-resistant power of the brain in enabling self-expression and communication.

**For instance, how can you determine which aspects of a domain, such as music and musicality, are creative and which ones are ordinary?**
This is a wonderful question that has several potential answers depending on the level of analysis or reflection that is adopted. In the domain of music and musicality that you mention, one can distinguish between the formats of listening, performance, improvisation and composition. If one adopts the standard definition of creativity, then improvisation and composition would be considered the most clearly creative forms given that both evidence the potential invention of original responses. One has to, of course, bear in mind some caveats here: that all improvisation is not necessarily creative, for instance. But there is good reason to also consider musical performance as a creative endeavor given that original responses are possible not only at the level of invention but also at the level of expression. This is after all among the key reasons why some musicians can command a higher ticket price than others—because of their originality in interpretation and expression. Some scholars go even further in claiming that even the act of listening to music can also be plausibly regarded as a creative enterprise. This is because the power to discern originality in the response patterns of others—via musical invention/expression—necessarily involves expanding one's own conceptual boundaries in the process.

**Is brain plasticity truly possible? If so, to what extent? How can creative thinking both induce and be caused by brain plasticity?**
Brain plasticity is a fact. Our brains change throughout our life span, and this is readily evidenced by the everyday observation that we never stop learning. The extent of brain plasticity is harder to define and hasn't been systematically examined. Creative thinking involves the discovery of novel connections and is therefore tied intimately to learning. Arthur Koestler pointed this out rather beautifully several decades ago: "Creative activity is a type of learning process where the teacher and pupil are located in the same individual."

**How are dopamine, neurological functioning and creativity related?**
There is indirect evidence to suggest that the association between these factors is a promising one, but further and more direct investigations are necessary to ascertain the nature of this relation. The idea that dopamine exerts an influence on motivational facets of the creative drive was pointed out most prominently by Alice Flaherty in the early 2000s. Contemporary formulations by the research group led by Carsten de Dreu emphasize the need to distinguish between prefrontal dopamine and striatal dopamine as facilitating different aspects of creative ideation, namely persistence and flexibility, respectively.

**In general, how do the neurological correlates of artistic engagement—composing a melody, writing a poem, painting a picture or choreographing a dance sequence—differ from what occurs in the brain when we generate a new theory or a scientific hypothesis?**

We know surprisingly little about the neurological correlates of scientific creativity. It simply has not been investigated nearly enough in a direct manner. But we can derive sound expectations from what we know about the brain basis of different types of reasoning and problem-solving processes as well as from behavioral studies. The latter point to the importance of accruing knowledge beyond one's field of expertise, the ability to focus on the unexpected, and the relevant influence of group factors in the work context.

Research on different artistic forms of creativity (musical, literary, kinesthetic, visual) are similar in emphasizing how the relevant perception, imagery, cognitive and motor skills become heightened as a function of expertise, the unique experience of flow as well as the vital dynamism between exteroceptive and interoceptive factors during creative performance. The relevant brain networks that underlie these functions are thereby implicated in the same. One must also bear in mind that there are several differences between the artistic creativity forms in terms of temporal properties of the creative experience, levels of social isolation associated with creative practice, the creator-recipient relationship, the propensity for mental illness, and so on.

As it currently stands, the brain basis of creativity with regard to the distinct creative domains is still at the nascent stage. This is primarily because there are serious challenges to neuroscientifically examining domain-specific forms of creativity. They typically involve gross motor action (kinesthetic creativity) or fine motor action (musical creativity, literary creativity, visual artistic creativity), and most neuroscientific methods are not conducive to a great deal of movement. Temporal factors also pose significant stumbling blocks in this regard. Neuroscientific methods are great at capturing the workings of the brain as derived from neural activity in short-term present. But the creation of a formidable work of art, a skillful performance, or a novel scientific theory all transpire over extended and variable periods of time. So the neural basis of these is less well known. Luckily for us increasingly more scholars are inventive in being able to tap creative processes across domains by using oblique approaches. So a fascinating picture is slowly unraveling. **M**

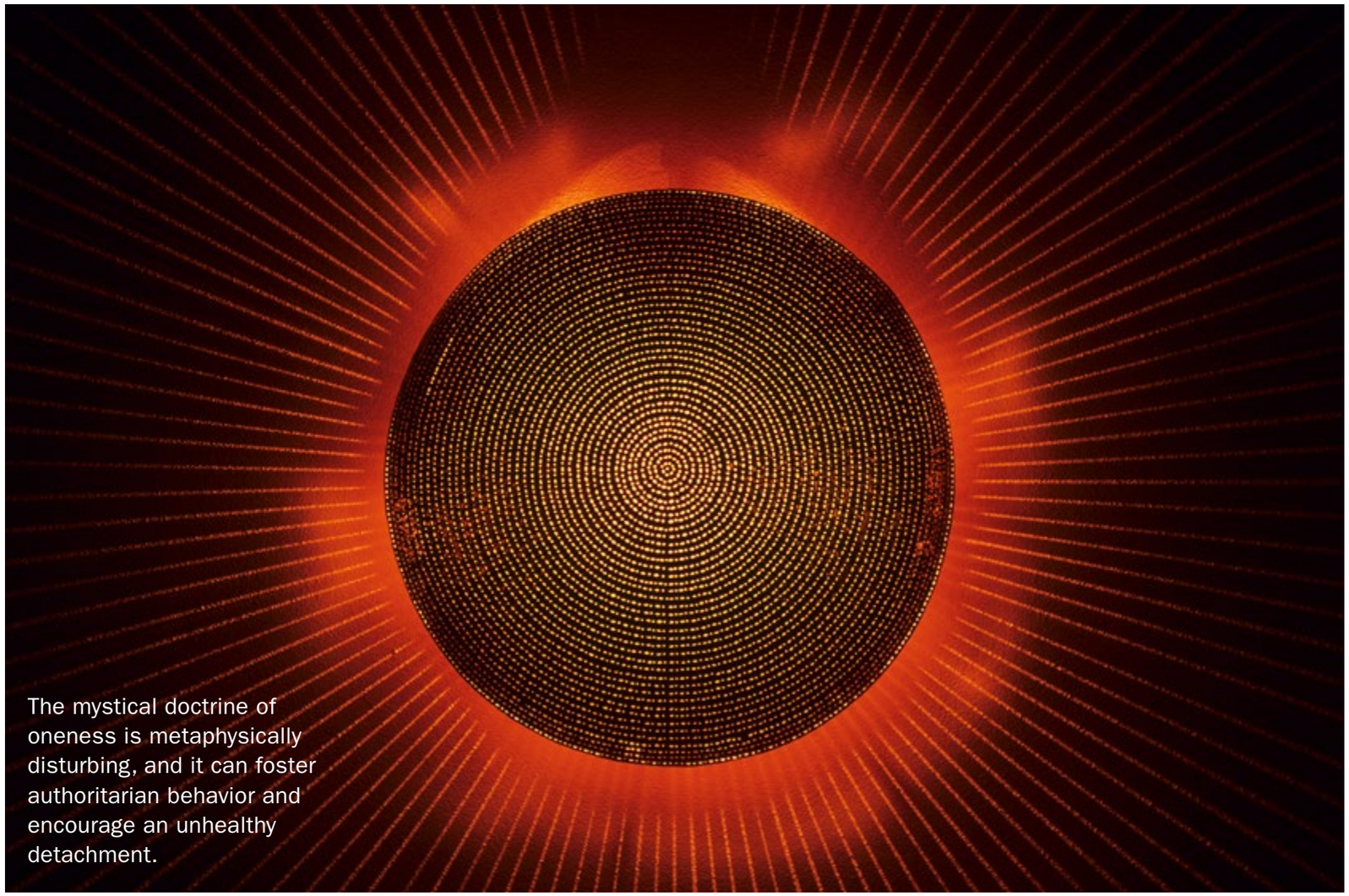
**John Horgan** directs the Center for Science Writings at the Stevens Institute of Technology. His books include *The End of Science* and *The End of War*.



BEHAVIOR & SOCIETY

# Don't Make Me One with Everything

## The mystical doctrine of oneness has creepy implications



The mystical doctrine of oneness is metaphysically disturbing, and it can foster authoritarian behavior and encourage an unhealthy detachment.

MARK D CALLANAN *GETTY IMAGES*

A recurring claim of sages east and west is that reality, which seems to consist of many things that keep changing, is actually one thing that never changes. This is the mystical doctrine of oneness. Enlightenment supposedly consists of realizing your oneness with reality, hence the old joke: What did the Buddhist say to the hot dog vendor? *Make me one with everything*.

A column by my fellow *Scientific American* blogger, psychologist Scott Barry Kaufman, touts the oneness doctrine. "The belief that everything in the universe is part of the same fundamental whole exists throughout many cultures and philosophical, religious, spiritual and scientific traditions," Kaufman writes. His column considers, as his headline puts it, "What Would Happen If Everyone Truly Believed Everything Is One?"

Kaufman notes that psychologists Kate Diebels and Mark Leary have explored this question. They define oneness, among other ways, as the idea that "beneath surface appearances, everything is one," and "the separation among individual things is an illusion." Diebels and Leary found that 20 percent of their respondents have thought about oneness "often or many times," and many report having spiritual experiences related to oneness.

Diebels and Leary state that "a belief in oneness was related to values indicating a universal concern for the welfare of other people, as well as greater compassion for other people." Believers "have a more inclusive identity that reflects their sense of connection with other people, nonhuman animals and aspects of nature."

The world might become a better place, Kaufman suggests, and politics less divisive, if children are taught to believe in oneness. Kids could learn "how underneath the superficial differences in opinions and political beliefs, we all have the same fundamental needs for connection, purpose and to matter in this vast universe."

Teaching kids oneness seems like a fine idea, if oneness is equated merely with recognition of how much we have in common with other humans, and indeed all of nature. These tenets underpin liberal democracy and environmentalism. But I have concerns about the mystical doctrine of oneness, which I explore in *Rational Mysticism*.

Various theologies, such as Gnosticism and the Kabbalah, suggest that not even God can bear to dwell in absolute oneness. That is why He created this flawed, fractured world. In her fascinating new book *The Voice of Sarah*, subtitled *Feminist Ethics in Jewish Sacred Text*, psychologist Susan Schept writes that God "needs relationship with humanity ... God is not God without response from human beings."

The Victorian poet G.K. Chesterton implicitly questions the notion of oneness in his poem "Mirror of Madmen." The poem's narrator dreams that he has ascended to heaven, where he finds to his horror that other ascended souls, saints and angels have the same face, his face. He wakes up just before seeing God.

The movie *Being John Malkovich* presents an a-religious version of this nightmare. A puppeteer discovers an air-conditioning shaft that serves as a portal into the brain of actor John Malkovich. Those who enter the portal see and feel what Malkovich does.

**The theory of evolution, and common sense, tells us that we are kin to all living things, so we should care for each other and for all of life.**

Malkovich, playing himself, enters the portal and finds himself in a restaurant in which everyone—waiters and diners, men and women, even a little girl—has his face and is saying, "Malkovich, Malkovich, Malkovich." Thou art Malkovich.

These works pose deep questions. Do we really want to live in a world in which there is no other? There are no selves but only a single Self? Is that heaven or a solipsistic hell? Isn't some separation from ultimate reality necessary for us to appreciate it? Love, the sublime emotion, requires at least two things, the lover and the beloved. So does consciousness. As the Hindu sage Ramakrishna said, "I want to taste sugar, I don't want to *be* sugar."

During a psychedelic trip in 1981, I had a taste of oneness. I became the only conscious entity in existence, an all-powerful cosmic computer at the end of time. It started out as a good trip, but then it became very bad. I felt excruciating loneliness and fear. The trip convinced me that the reduction of all things to one thing is a route not to cosmic consciousness but to unconsciousness, oblivion, death. One thing equals nothing.

The iconoclastic spirituality teachers Diana Alstad and Joel Kramer raise other objections to oneness in their 1993 book *The Guru Papers*. Oneness appeals to modern westerners, they argue, because it seems superficially less authoritarian and more abstract—and hence easier to reconcile with liberalism and science—than monotheistic theologies. Oneness also seems to counter our innate selfishness.

But oneness, Alstad and Kramer point out, "has within it a hidden duality" that leads to social hierarchies. Buddhism and Hinduism claim that Buddha and other enlightened beings transcend their individuality and experience oneness in a deep and abiding fashion. All are one, but some are more one than others.

"The very nature of any structure that makes one person different and superior to others," Alstad and Kramer state, "breeds authoritarianism." Supposedly enlightened gurus often insist that only through total surrender to them can others achieve enlightenment. Ashrams, monasteries and other organizations that preach oneness are often hierarchal and patriarchal.

To sum up: The mystical doctrine of oneness is metaphysically disturbing, and it can foster authoritarian behavior. The conviction that this multitudinous world is illusory can also encourage an unhealthy detachment, which undermines efforts to solve problems like war, injustice and climate change.

The theory of evolution, and common sense, tells us that we are kin to all living things, so we should care for each other and for all of life. Let's teach our children this deep empirical and moral truth. But let's spare them the more extreme doctrine of oneness.

**Scott Barry Kaufman** is a psychologist, author and podcaster who is deeply interested in using psychological science to help all kinds of minds live a creative, fulfilling and meaningful life. Kaufman has over 60 scientific publications on intelligence, creativity, personality and well-being. In addition to writing the column Beautiful Minds for *Scientific American*, he also hosts The Psychology Podcast. He is also the author and editor of eight books. Kaufman received a Ph.D. in cognitive psychology from Yale University and an M. Phil. in experimental psychology from the University of Cambridge.



COGNITION

# Can Intelligence Buy You Happiness?

**New research suggests that higher IQ leads to greater well-being by enabling one to acquire the financial and educational means necessary to live a better life**

GETTY IMAGES

In his classic 1923 essay, "Intelligence as the Tests Test It," Edwin Boring wrote "Intelligence is what the tests test." Almost a century of research later, we know that this definition is far too narrow. As long as a test is sufficiently cognitively complex and taps into enough diverse content, you can get a rough snapshot of a person's general cognitive ability—and general cognitive ability predicts a wide range of important outcomes in life, including academic achievement, occupational performance, health and longevity.

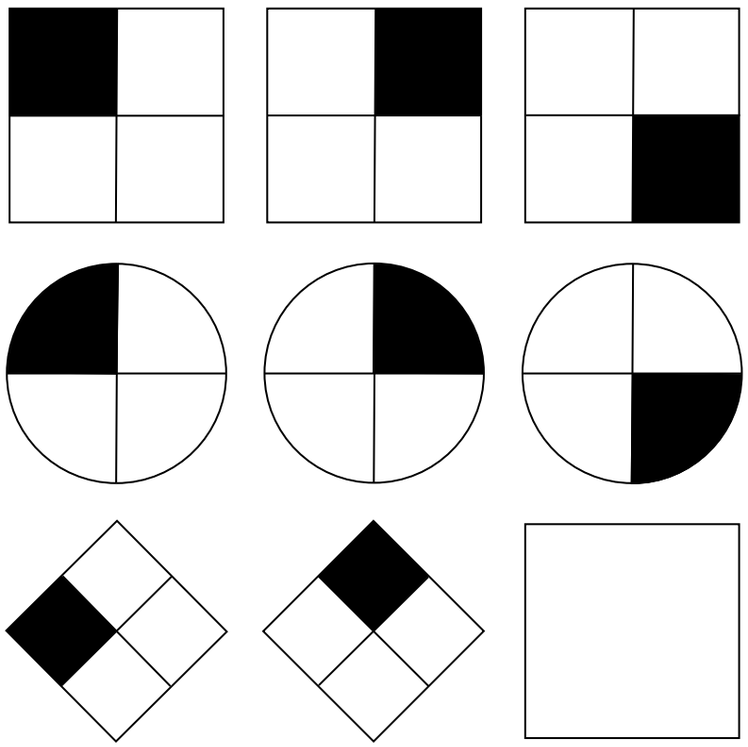
But what about happiness? Prior studies have been mixed about this, with some studies showing no relationship between individual IQ and happiness, and other studies showing that those in the lowest IQ range report the lowest levels of happiness compared to those in the highest IQ group. In one study, however, the unhappiness of the lowest IQ range was reduced by 50 percent once income and mental health issues were taken into account. The authors concluded that "interventions that target modifiable variables such as income (e.g., through enhancing education and employment opportunities) and neurotic symptoms (e.g., through better detection of mental health problems) may improve levels of happiness in the lower IQ groups."

One major limitation of these prior studies, however, is that they all rely on a single measure of happiness, notably life satisfaction. Modern-day researchers now have measures to assess a much wider array of indicators of well-being, including autonomy, personal growth, positive relationships,

self-acceptance, mastery and purpose and meaning in life.

Enter a new study conducted by Ana Dimitrijevic and colleagues, in which they attempted to assess the relationship between multiple indicators of intelligence and multiple indicators of well-being. They relied on the following definition of intelligence: "the ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, and to overcome obstacles by taking thought." This definition covers several more specific notions of intelligence, such as emotional intelligence.

The researchers administered a battery of intelligence and well-being measures to 288 adults employed within various departments of a large dairy production company in Belgrade. What did they find?



### Intelligence and Well-Being

The researchers found that both IQ and emotional intelligence were independently correlated with well-being.* IQ was positively correlated with personal relationships, self-acceptance, personal growth, mastery and purpose in life.† Emotional intelligence was correlated with the same well-being measures, but was additionally related to a sense of autonomy in life.

Zooming in on the IQ test, the most predictive subscale for well-being was a measure of *non-verbal fluid reasoning*, which requires pattern detection and abstract reasoning (constructing generalizable principles from minimal information). Some people argue that this form of reasoning is strongly related to general intelligence.

Once socioeconomic status (SES) was taken into account (reflecting higher education and income), however, *there was no relationship between IQ and well-being*. According to the researchers, this suggests that IQ leads "to greater contentment with oneself and life primarily by enabling one to acquire the social status and financial means which ensure better opportunities and quality of life." Of course, this does *not* mean that IQ is simply a measure of SES; IQ was positively correlated with well-being. However, it does suggest that the extent to which IQ is related to happiness depends to a large extent on the opportunities (e.g., financial, educational) you have to utilize your IQ.

What about emotional intelligence? The emotional intelligence tests that were most predictive of well-being were the two higher, more "strategic" branches—*understanding and managing emotions*. The person who scores higher in these facets of emotional intelligence are better able to comprehend the emotional signals coming from others, and to regulate and manage their own and others' emotions so as to further their own and others' personal and social goals.

Emotional intelligence had a *direct* effect on well-being, and this association remained strong even after controlling for SES. What's more, of the two measures of intelligence—IQ and emotional intelligence—*emotional intelligence was the strongest predictor of well-being*, outweighing not only IQ, but also a person's SES and age. This finding suggests that emotional intelligence—particularly the capacity to manage one's emotions toward optimal personal goal attainment—is a form of intelligence that can help people live a more fulfilled life regardless of their economic circumstances.

### Why Is Intelligence Associated with Well-Being?

I think intelligence matters for a fulfilling life for a number of reasons. For one, a higher IQ is a gateway to better education. Those with higher IQ scores are much more likely to score well on standardized tests of achievement, and academic performance is often the first hurdle necessary to continue up the ladder of occupational opportunities.

Also relevant here is the association between IQ and openness to experience. Those with a higher IQ tend to score higher in a number of facets of openness to experience, including intellectual engagement, intellectual creativity, introspection, ingenuity, intellectual depth and imagination. This tendency for deeper cognitive processing is critical for dealing with a lot of life's up and downs. While trauma is inevitable in life, research shows that we can grow from our traumas if we have a healthy form of rumination in which we reflect on the deeper meaning of the event and can use that cognitive processing to perceive greater opportunities for ourselves and others.

Regarding emotional intelligence, since having a fulfilling life often requires accomplishing the goals

you have set out for yourself, it makes sense that being able to manage your emotions in the service of a larger goal will be associated with well-being and self-actualization.

Perhaps the most important analysis will turn out to be how IQ and emotional intelligence interact. There is some evidence that in certain contexts, emotional intelligence can amplify the effectiveness of a high IQ, and high emotional intelligence can even compensate for a lower IQ. Future research should definitely look more closely at the interaction between these two important aspects of human intelligence.

Of course, it's possible that the findings operate in reverse causation, and being happier increases intellectual skills. Most likely, both directions are at play in the correlations found in the study. Clearly more research will need to look at the association between intelligence and well-being over time.

At any rate, I'm pleased to see that this line of research is being conducted. I believe a great responsibility we have as a society is to ensure that all people—regardless of their IQ score—are able to self-actualize and lead a life of self-acceptance, autonomy, meaning and positive social relationships.

*It should be noted that IQ and emotional intelligence were moderately correlated with each other. This suggests that both tests are tapping into a common set of processes (e.g., executive functioning, working memory, etc.), even though IQ and emotional intelligence also involve a partially different set of skills.

†The researchers provided this more detailed analysis of well-being upon my request.

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POLICY & ETHICS

# In the Nature-Nurture War, Nature Wins

**Environmental influences are important, too, but they are largely unsystematic, unstable and idiosyncratic**

TIM ROBBERTS *GETTY IMAGES*

When psychology emerged as a science in the early 20th century, it focused on nurture, the environmental causes of behavior. Environmentalism—not the ecological kind, but rather the view that we are what we learn—dominated psychology for decades. From Freud onward, the family environment was assumed to be the key factor in determining who we are. In the 1960s geneticists began to challenge this view. Psychological traits such as mental illness clearly run in families, but there was a gradual recognition that family resemblance could be due to nature (genetics) rather than nurture (environment) alone, because children are 50 percent similar genetically to their parents.

During the past four decades, scientists have conducted long-term studies on special relatives like twins and adoptees to test the effects of nature and nurture. This research has built a mountain of evidence showing that genetics contributes importantly to all psychological differences between us. In fact, inherited DNA differences account for about 50 percent of the differences between us, in our personality, mental health and illness, and cognitive abilities and disabilities.

The word "genetic" can mean several things, but here it refers to differences in DNA sequence, the three billion steps in the spiral staircase of DNA that we inherit from our parents at the moment of conception. It is mind-boggling to think about the long reach

of these inherited differences that formed the single cell with which we began life. They affect our behavior as adults, when that single cell with which our lives began has become trillions of cells, all with the same DNA. They survive the long and convoluted developmental pathways between genes and behavior, pathways that meander through gene expression, proteins and the brain. The power of genetic research comes from its ability to detect the effect of these inherited DNA differences on psychological traits without knowing anything about the intervening processes.

Understanding the importance of genetic influence is just the beginning of the story of how DNA makes us who we are. Studying genetically informative cases like those of twins and adoptees led to some of the biggest findings in psychology because, for the first time, nature and nurture could be disentangled.

One of the most remarkable discoveries is that even most measures of the environment that are used in psychology—such as the quality of parenting, social support and life events—show significant genetic impact. How is this possible when environments have no DNA themselves? Genetic influence slips in because the environment is not randomly "out there" independent of us and our behavior. We select, modify and even create our environments in line with our genetic propensities. Correlations between such so-called environments and psychological traits don't necessarily mean that the environments cause the traits. For example, parental negativity correlates with their children's antisocial behavior, but this doesn't mean that the parents cause their children's antisocial behavior. Instead, this correlation is substantially caused by parents responding negatively to their children's genetically driven propensities.

A second crucial discovery is that the environment works completely differently from the way environmentalists thought it worked. For most of the 20th century, environmental factors were called nurture because the family was thought to be crucial in determining environmentally who we become. Genetic research has shown that this is not the case. We would essentially be the same person if we had been adopted at birth and raised in a different family. Environmental influences are important, accounting for about half of the differences between us, but they are largely unsystematic, unstable and idiosyncratic—in a word, random.

The DNA differences inherited from our parents at the moment of conception are the consistent, lifelong source of psychological individuality, the blueprint that makes us who we are. A blueprint is a plan. It is obviously not the same as the finished three-dimensional structure. The environment can alter this plan temporarily, but after these environmental bumps we bounce back to our genetic trajectory. DNA isn't all that matters, but it matters more than everything else put together in terms of the stable psychological traits that make us who we are.

These findings call for a radical rethink about parenting, education and the events that shape our lives. It also provides a novel perspective on equal opportunity, social mobility and the structure of society.

The nature-nurture war is over. Nature wins, hands down.

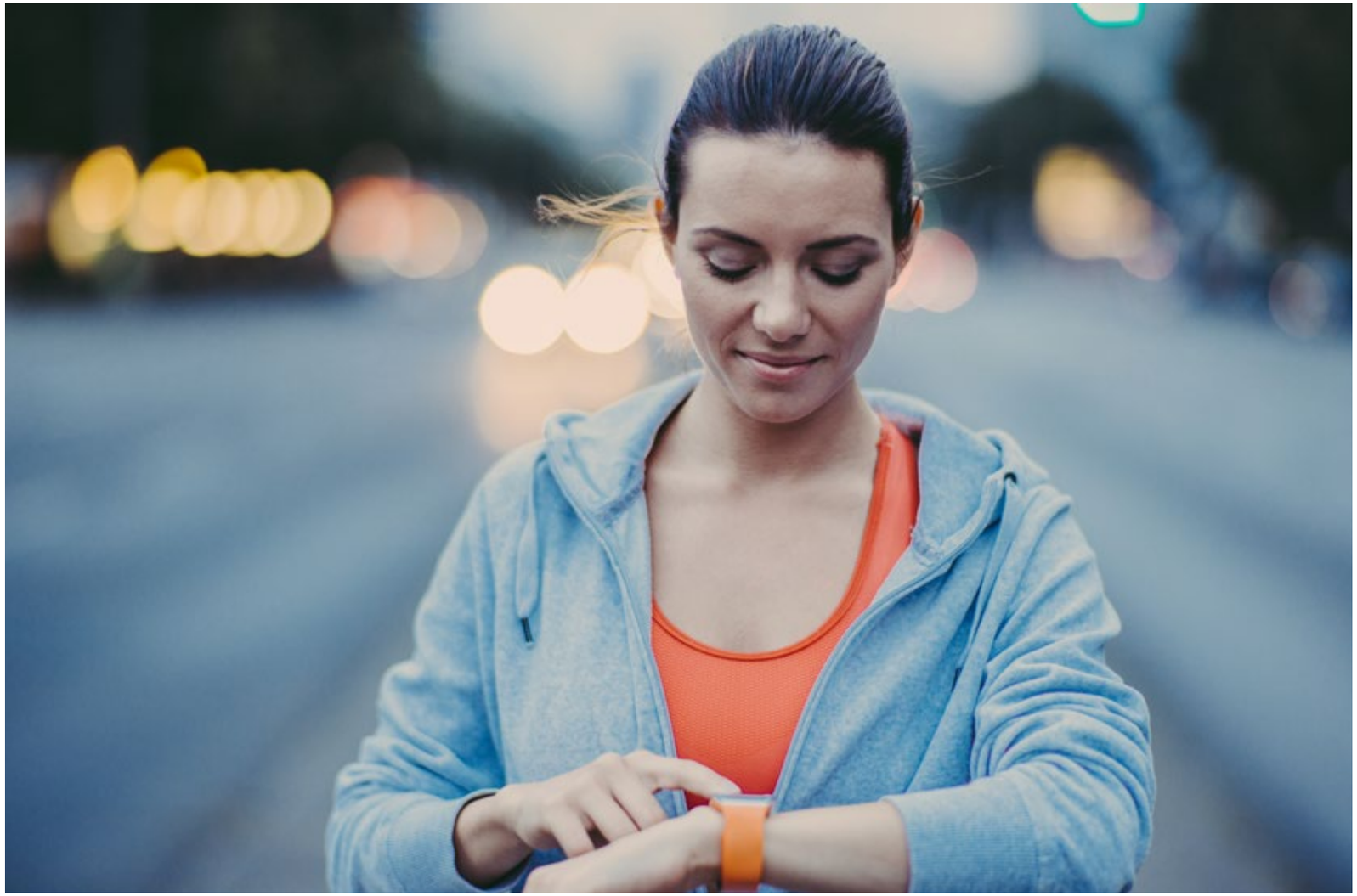
**Brett Frischmann** is Charles Widger Endowed University Professor in Law, Business and Economics at Villanova University. His books include *Re-Engineering Humanity* and the novel *Shepard's Drone*.



BEHAVIOR & SOCIETY

# Is Smart Technology Making Us Dumb?

**Yes and no: there are reasonable arguments on both sides of the question**



GUIDO MIETH *GETTY IMAGES*

We still haven't grappled with the deep questions Nicholas Carr brought to public attention in his seminal book, *The Shallows: What the Internet Is Doing to Our Brains* (2010). Is the Internet making us dumb? Is the technology causing us cognitive loss or debilitation? Carr focused on the Internet, which is, by design, a dumb technology—a general-purpose digital communication infrastructure that pushed "intelligence" to the ends of the network.

Since my own book *Re-Engineering Humanity,* co-authored by Evan Sellinger, was published, I'm often asked: Is smart technology making us dumb? My first reaction is to bounce a few questions back. Can technology really be smart? Is your question whether our use of certain technologies is making us dumb? Or is your question about technology companies?

Eventually, I return to the original question and respond like a lawyer: It depends. It's yes in some ways and no in others. Before addressing it, we must acknowledge the conceptual mistake of boiling intelligence down to a binary—smart versus dumb—as if it exists on a single dimension. There are many different types of intelligence that matter, and how technology affects different types also varies considerably.

Once I'm done meandering, however I answer yes. I believe we may be making ourselves dumber when we outsource thinking and rely on sup-

posedly smart tech to micromanage our daily lives for the sake of cheap convenience.

The Internet provides us with seemingly limitless data, prose, images, video and other raw materials that could in theory enhance our intelligence and enable us to become more knowledgeable, to be more skillful or to otherwise use actionable intelligence. Maybe we could improve our decision-making, reflect on our beliefs, interrogate our own biases, and so on.

But do we? Who does? Who exactly is made smarter? And how? And with respect to what? Are you and I, and our siblings and children, engaging with the seemingly limitless raw materials in a manner that makes us more capable, more intelligent? Or do we find ourselves outsourcing more and more? Do we find ourselves mindlessly following scripts written or designed by others?

We're easily led to believe that we're extending our minds and becoming more intelligent with a little help from the digital tech tools, when in reality, those are often just illusions, sales pitches optimized to pave the path of least resistance. Every time someone suggests they've extended their mind with their smartphone, that they are thinking through and with their phones, I respond by asking them about who's doing what thinking.

Are they extending their mind or extending the reach of others into their mind? When you rely on GPS, who's doing the route planning? Who is gaining what intelligence? Are you smarter because of GPS? What impact does outsourcing navigation and awareness of your surroundings have on your capabilities? Certainly, Waze or Google gain intelligence about you, your surroundings and even others around you. That could be good or bad, but it's not really extending your mind or expanding your intelligence.

**But the bottom line is that digital tech companies get smarter, more capable, more powerful.**

As everyone knows by now, many digital tech companies know a lot about each of us. Advertisers, Cambridge Analytica–like firms, large platforms and so on. They've gained considerable intelligence and, as a result, power. But note that for the most part, they feed on different raw materials. They don't get smart by consuming the same materials that we're fed.

They gain actionable intelligence by collecting treasure troves of data, gleaned from digital networked technologies. Everything that occurs on the Internet—every interaction, transaction, communication, etc.—everything is data, strings of 0s and 1s. And all of our activities generate data. Digital tech companies gain actionable intelligence by collecting and processing data, mostly about how we behave in response to different stimuli—what we're fed. This empowers those companies. They may, for example, personalize their services to induce desirable behaviors, such as sustained engagement. Or they may develop new salable insights about consumers. I could go on. But the bottom line is that digital tech companies get smarter, more capable, more powerful.

But what about you and me? Do we also get smarter? Do we extend our minds and thereby gain intelligence and increased capabilities? What actual capabilities are extended or enhanced? Are they in fact practiced? If so, to what end? What actionable intelligence improves the quality of your life?

Upon reflection, I remain uncertain. Again, the lawyer in me emerges, and I can reach no definitive evaluation. Does that say something about me and my reflective capacity, the ambiguity of empirical evidence, or something else?

The Internet promised the library of Alexandria at our fingertips, delivered instantaneously wherever and whenever we like. It delivered that and much, much more. One might describe the exchange in Faustian terms, as trading one's soul for knowledge. Putting aside concerns about what's been lost (our soul, humanity, etc.), it's not even clear that the promised knowledge was delivered. To make matters worse, evaluating the Faustian bargain is even more difficult when the intellectual capabilities required to do so seem to be waning, at least for many of us.

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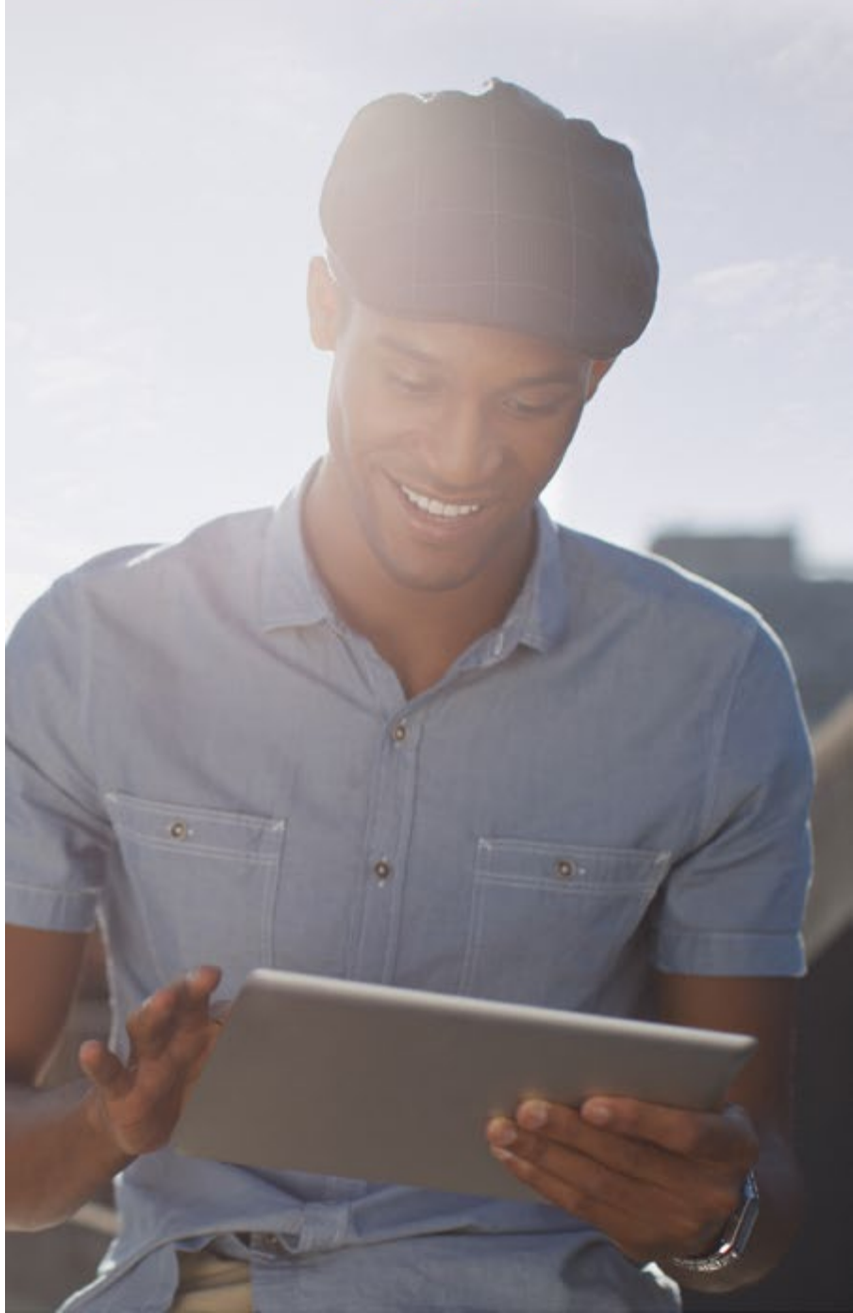

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