The EVOLUTION *of* TROLLING

Understanding the scientific underpinnings of toxic online behavior.

By **CYNTHIA ELLER**

What causes people to display more toxic behavior when interacting with others online rather than in person? Caltech's Dean Mobbs, professor of cognitive neuroscience, along with postdocs Swati Oandity and Ketika Garg, and former research assistant Jianjin Zhang, have constructed a theoretical model to answer that question.

Mobbs, who is also the director and Allen V. C. Davis and Lenabelle Davis Leadership Chair of the Caltech Brain Imaging Center, and an affiliated faculty member of the Tianqiao and Chrissy Chen Institute for Neuroscience at Caltech, calls the model he and his team created the DAD framework (Disembodiment, lack of Accountability, and Disinhibition). The factors that comprise the framework's name make it more likely that social media interactions skew toward a level of nastiness and misinformation not seen in face-to-face communication.

First, disembodiment: In most social media exchanges, people have no direct sensory experience of one another. "When I'm speaking to somebody online, the conversation I'm having is all in my head; it's completely disembodied," Mobbs explains. Without cues from another's facial expressions or body position, these interactions, though they may feel external, are transacted entirely within one's internal world. It is here, Mobbs says, where the problem lies. "Your internal world is your playground not just for ideas or for what you want to say, but sometimes for things you shouldn't say. When you are communicating in this disembodied state, having a conversation in your mind, you begin to forget that you're having a conversation with a real person."

Lack of accountability occurs when social and cultural norms that operate in person to provide checks on interpersonal communication are absent and, with anonymity, even the fear of criminal punishment is gone. "I can say something via text on social media, and, often, I don't have to pay the consequences of saying it," Mobbs says. "I don't get social disapproval at the same level I would as if I were with someone in person, and, frequently, I either am or believe myself to be completely anonymous."

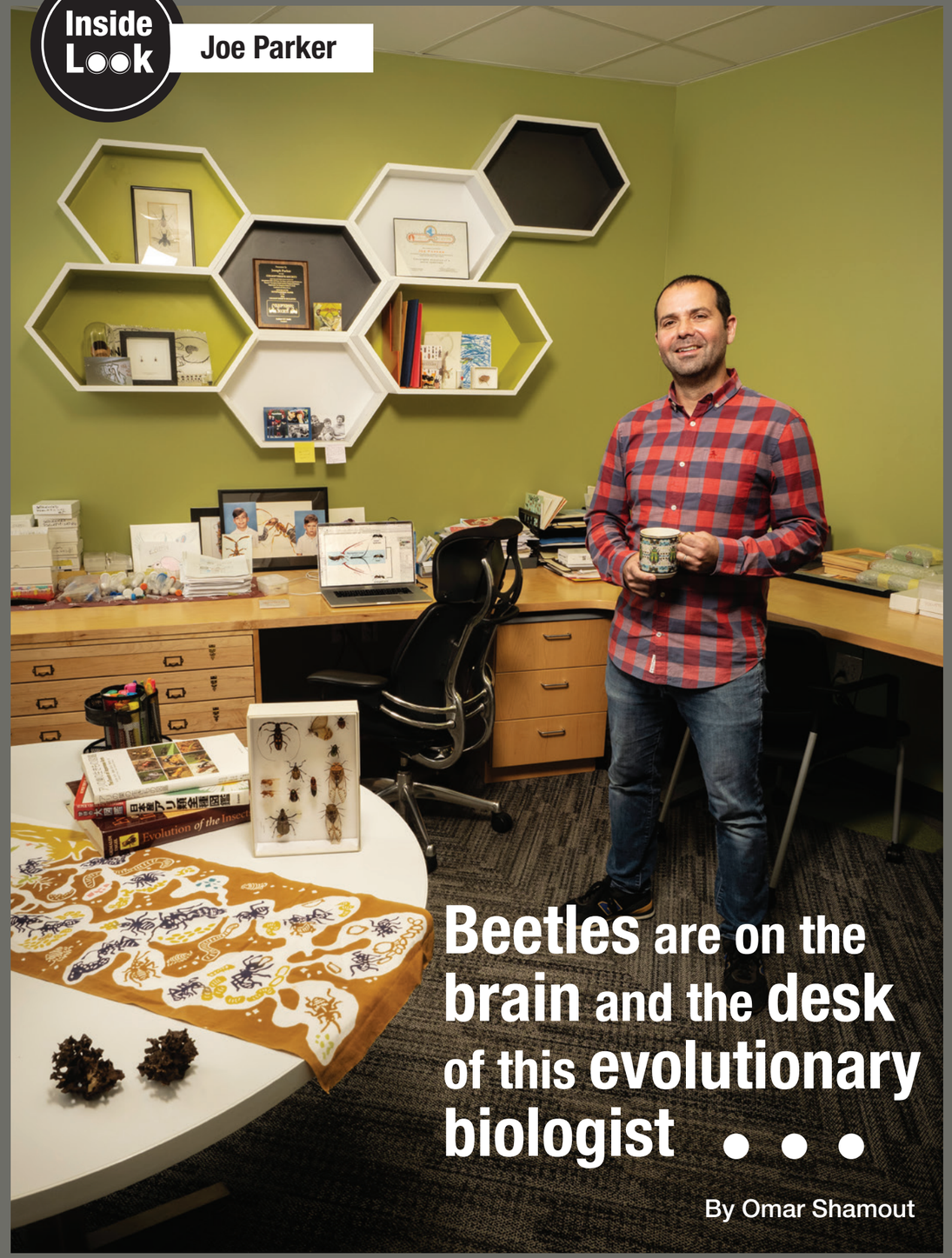
The first two factors lead to the third: disinhibition. "It is disinhibition that allows you to say whatever you think, whatever you want," Mobbs says. "All of those nasty thoughts that you have in your head can just come out of your fingertips without interference."

The DAD framework is grounded in an evolutionary perspective on emotion that is at the core of Mobbs's research. "Other animals have different strategies, such as camouflage or enhanced senses that detect threats, but we typically rely on avoiding predators before actually encountering them. We have not evolved for a social media environment," Mobbs says. "The sensory systems and theory of mind systems we have evolved in previous millennia do not translate well into an online domain," which leads to the "impaired interactions" that create online toxicity.

Mobbs and his co-authors suggest accountability can be strengthened by forcing users to register their social media accounts under their legal names, by slowing down the rate of interactions, or by introducing AI content moderators to provide more time for users to think about the consequences of their actions. Even the simple use of emoticons and avatars can help to mitigate the effects of disembodiment on our online behavior as they help to make others appear more real and their feelings more apparent.

The paper, "Three roots of online toxicity: disembodiment, accountability, and disinhibition," appears in the September 2024 issue of *Trends in Cognitive Sciences*. The work was funded by a gift from Sonja and William Davidow.

Inside Look **Joe Parker**



Beetles are on the brain and the desk of this evolutionary biologist • • •

By Omar Shamout

. . . Joe Parker calls California "frontier territory" for undiscovered insects. The Caltech entomologist and evolutionary biologist estimates he has found dozens of new species since arriving at the Institute in 2017 and possibly thousands during his lifetime. "I would need several more lifetimes to actually put names on everything," he says.

While Parker unearthed many of these specimens doing field work in the nearby San Gabriel Mountains, he did not even have to leave home to make one recent find. "We wanted to study the chemical defense gland of a beetle species attracted to flesh flies, which gather on rotting mammal carcasses," says Parker, an assistant professor of biology and biological engineering, director of the Center for Evolutionary Science (CES), and a Chen Scholar. "So, my kids and I put dead rats behind our fence in South Pasadena. As soon as the rats started getting munched by flesh-fly larvae, some beetles showed up. It turns out, there's a species that had never been found that was living, literally, in our backyard, and we now have a whole genome sequence for it."

Parker, who was recently named a MacArthur Fellow, has loved bug hunting since he was a kid growing up in Swansea, Wales. A childhood hobby turned into a lifelong passion at age 7, when Parker visited the National Museum of Wales with his father and toured a zoology exhibit. "There was an insect display with a giant southeast Asian cicada," he recalls. "It was completely mesmerizing with its bulbous eyes, almost mechanical body segments, and huge wings. I just thought, 'There's a parallel world on planet Earth, and it's the world of insects.'"

Today, Parker's lab focuses on the symbiotic relationship between insect species, particularly rove beetles and ants. Rove beetles (*Staphylinidae*), which live in soils and dead leaves around the world, represent a sprawling radiation of over 66,000 species, making them not only the largest known beetle family but the largest known family in the entire animal kingdom. Parker's team studied one group of rove beetles that has evolved to mimic ant pheromones or produce chemicals that pacify aggressive worker ants, enabling the beetles to live symbiotically with the ants and even prey upon them.

"There's a parallel world on planet Earth, and it's the world of insects."

Recently, Parker and colleagues, including Caltech Professor of Biology Mitchell Guttman, assembled whole genomes from species spanning the rove beetle's evolutionary tree. They analyzed the genes expressed in two cell types found in a gland on the abdomen of rove beetles; this enabled the researchers to uncover a genetic toolkit that evolved over 100 million years ago to equip these insects with their powerful chemical defenses. "What you have in these beetles is a virtuoso example of organisms evolving new ways to interact with other species," Parker says.

Through his role as director of the CES, Parker is able to offer seed funding to a wide variety of research projects across the Institute. "The center has managed to start nascent projects in labs that may not previously have had the opportunity to do something with an evolutionary dimension to it," he says.

The design of Parker's office in Caltech's Mabel and Arnold Beckman Laboratories of Behavioral Biology is appropriately insect themed: The hexagonal shelving and floor tiles are inspired by insects' compound eyes, and the carpet pattern is reminiscent of an insect's wings. Framed insect specimens sit around his desk, which also contains thousands of tiny nonliving specimens housed in custom glass-encased drawers. Glass walls in his office and lab are adorned with enlarged versions of his own insect line drawings.

Despite working in such a buggy sanctum, Parker enjoys going outside to hunt for new colonies to study. "I love being in the field," he says. "I worked in sterile biomedical campuses as a PhD student and postdoc, but I grew up rooting around in the dirt. Bringing those two ways of looking at insects together was always something I wanted to do."

Here are some of the objects adorning Parker's office.

Beetles encased in amber

Parker keeps this 99-million-year-old amber deposit on the shelf above his desk. Inside are some of the first species of rove beetles to evolve on Earth, found in the same amber that encases the earliest-known ants. "This encapsulates a very important time in insect evolution, just as ants and other social insects were starting to appear," Parker points out. "It embodies an ecosystem before ants rose to ecological dominance."

Beetle treadmill

Parker's lab uses this tiny sphere, affectionately known as a beetle treadmill, to study how the insects behave and interact with ants and other stimuli in real time. It was given to Parker by his colleague Michael Dickinson, the Esther M. and Abe M. Zarem Professor of Bioengineering and Aeronautics, who wrote the names of Parker; Parker's wife, Heidi; and their oldest two children, Jonah and Eden, on the tiny white ball, which is about 1 centimeter in diameter. "The beetle walks along on this air-supported spherical treadmill," Parker says. "You can prod it with an ant or another stimulus to see if it deploys its chemical defenses. The names on the ball serve as landmarks so we can calculate its path and trajectory. This ball is older than my youngest son Oscar; he has his own."

The Guests of Japanese Ants (2013)

This book, which documents every species of organism in Japan that lives inside a colony, was co-written by entomologist Munetoshi Maruyama, a friend of Parker's. Japan, Parker says, is fertile ground for studying insects due, in part, to the humid climate and mountainous terrain. The field of entomology has also attained an uncommon level of mainstream attention in the country. "The best entomology in the world happens in Japan, and they have an appreciation for insects that is unique," he says. "This book would never have any market over here, but this is a popular book in Japan. Each one of the authors frequently appears on TV shows. They're almost like celebrities."

Velvety tree ant nest chambers

Colonies of the velvety tree ant build these intricate nest structures inside oak trees. Each colony contains perhaps a million ants, which together transform the insides of a trunk into a labyrinth of microchambers. "We call it the crunchy magic material," Parker says, noting the rove beetles studied by his lab, which pose as ants, also live in these nests. "Inside the tree is this incredibly complex microenvironment with probably thousands of these tiny chambers." Velvety tree ants bite, however, so collecting specimens can be dicey. "If you find a hole in a tree and reach inside to pull out the nest, you will get annihilated by the ants," he says.

Surrealist painting

Parker's father, John, a sociology professor, made this small painting, along with several others of a similar style, for his son. John has always enjoyed making art, though wood sculpture is his usual medium. A few years ago, John began to experiment with painting on thick blocks of wood. "Each one of them is kind of surrealist," Parker says, noting this piece contains shapes and figures that could be construed as insects. "Sometimes they converge into things that you recognize."

Beetle line drawing

Parker himself sketched this line drawing (at left) of a rove beetle based on a confocal image of the insect. The image was made by placing a specimen sample under a microscope and shining a laser on it, thereby illuminating its autofluorescent exoskeleton. Autofluorescence is naturally emitted light from cells and tissues. Many similar drawings of beetles and ants made by Parker decorate his lab and office.