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Anyone Can Be Trained to Hallucinate, and That's Teaching Scientists About Perception

We may all be susceptible to hallucinations—and they're not that different from how our brain interprets actual events.

BY [BIANCA DATTA](#) TUESDAY, AUGUST 15, 2017 [NOVA NEXT](#)



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Hallucinations are often distressing—a suggestion that something is amiss in our brains. But new research suggests we're all susceptible to hallucinations, and that may not be such a bad thing.

In a paper released last week in [Science](#), a team from Yale University set out to understand how we interpret the world around us—in short, how we determine what's real and what's not. They suspected that people who regularly hallucinate perceive the world based on what they expect to happen, while others, who don't hallucinate, would rely more what their senses are telling them is happening in the world.

To determine that, authors Phil Corlett and Al Powers began by conditioning participants to hear a tone when they were shown a checkerboard pattern. Then they slowly removed the actual sound and asked people when they heard it. Participants who regularly heard voices were five times more likely to say they heard a tone when there wasn't one, and they were 25-30% more confident in their choice. But they weren't alone in hearing things. In fact, all of the participants experienced some induced hallucinations during the experiment

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perform so similarly to people who did hear voices," Powers says. "They were very, very alike."

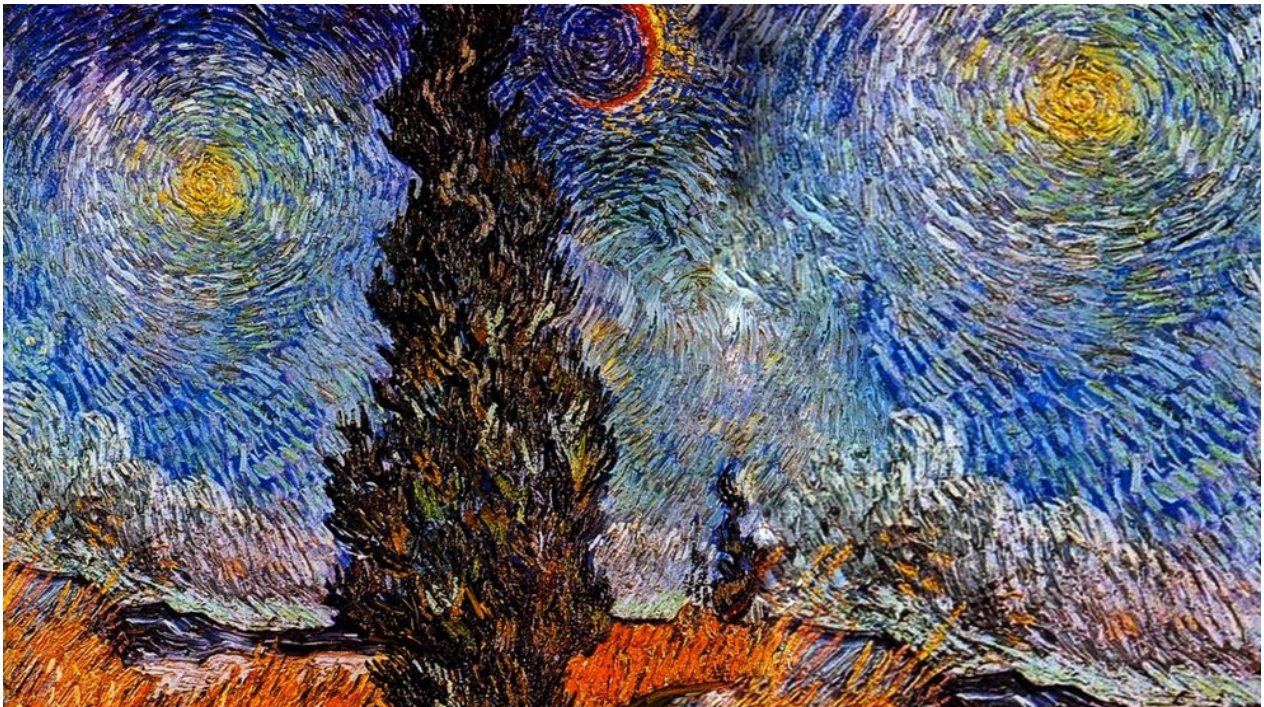
"Really healthy people that don't hallucinate in their everyday lives—graduate students, and postdocs, and highly accomplished people—were very, very susceptible to this effect, even the ones who didn't hear voices. They were more susceptible to it than I expected," Corlett says. The study contributes to the idea that schizophrenia, much like autism, may exist as a spectrum, the authors say.

Hearing Things

Powers personally experienced the phenomenon when testing the software for the experiment. He was surprised to find that, despite his deep knowledge

of the process and mechanisms, the effect still worked on him. “At the beginning, it was quite exciting,” he says, though he admitted that “it’s concerning, to be honest.”

He and Corlett compared four groups: those with diagnosed psychoses who either did or did not hallucinate and those not diagnosed with psychoses who either did or did not hallucinate. Each of the groups contained 14-15 people. Most of these participants were relatively easy to recruit. But they needed to find people who experience hallucinations as part of daily life yet haven’t been diagnosed with a psychiatric disorder. So they turned to the Connecticut Psychics’ Association, specifically to psychics who regularly hear voices.



Vincent van Gogh frequently suffered from psychotic episodes of hallucinations and delusions.

Many of the study participants who hallucinate but haven’t been diagnosed as psychotic tend to lead normal lives. The hallucinations don’t seem to interfere, like for a police officer in her 50s who heard daily narrations of her activities as she worked.

Powers and Corlett wanted to know if people diagnosed with psychoses had brains that operated differently than the other subjects. To do that, they had to

make people who don't typically hallucinate...hallucinate. And that's why they turned to a famous technique originally used on dogs—Pavlovian conditioning. The team conditioned participants to associate a checkerboard pattern with a 1-kHz tone, which sounds like the bleep over a swear on late-night TV. Initially, the scientists sprinkled in lots of 1-kHz tones that they were certain the participants could hear. Then, as the task went on, they changed their intensity and often removed them entirely. Like in a hearing test at the doctor, participants were asked to press a button when they heard the tone. In an added twist, participants could indicate how confident they were about their response. Meanwhile, their brains were examined using magnetic resonance imaging (MRI).

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The researchers found the psychics' descriptions of their hearings incredibly similar to the accounts of their psychotic hallucinating patients. That reinforced to Corlett and Powers that mental symptoms like hallucinations and delusions may exist on a continuum, from manageable occurrences to increasingly severe and disruptive clinical cases.

Meanwhile, the group with known psychosis but no regular hallucinations responded differently. While most participants were unable to tell real tones

from imagined ones, those in the psychotic, non-hallucinating group were more quickly and confidently able to determine the change.

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Corlett thinks this is because most of the people in the psychotic non-hallucinators group experience delusions, a phenomenon separate from hallucinations where they have trouble connecting different clues from their environment. “They have a real problem picking up the contingency between the checkerboard and the tones,” he says. “The importance of including this group is to say that what we found isn’t simply attributable to psychosis, but particular to hallucinations.”

Using MRI neuroimaging, the team was able to tie the underlying mechanism that causes auditory hallucinations to those used in normal perception. In other words, hallucinations prey on the same processes that allow us to see and hear. “We’re able to say that hallucinations are not just foreign, scary, unrelatable things, but are in fact a process or an alteration of a process that we ourselves undergo every day in deciding what surrounds us,” Powers says.

Role of Cultural Stigmas

Psychosis is typically defined as active hallucinations or delusions coupled with significant clinical distress, but there is still some debate over where the boundaries are. Up until now, schizophrenia has primarily been treated as a one condition, but Corlett and Powers think a symptom-by-symptom approach may serve patients better. Their work provides further evidence that there may not be one not one type of schizophrenia but many.

The study's findings also suggest that cultural or religious attitudes toward hallucinations may influence whether they are benign or disruptive, says anthropologist Tanya Luhrmann of Stanford, who studies unusual sensory experiences and their cultural implications. "It opens the possibility that if people with psychosis learn to expect to different things from their hallucinations, they might have different hallucinations," she says. "The content [of hallucinations] has something to do with prognosis—the more mean and negative the voices, the worse the outcome."

In the U.S., we tend to assume that psychotic experiences are inherently negative, but in her work, Luhrmann has found that that's not always the case in other cultures. Evidence by other scientists and anthropologists suggests that the more negatively one perceives their voices, the worse their outcome.

"These hallucinations, either with neural feedback or with some kind of more spiritual training, might benefit these patients."

Luhrmann was intrigued by those who hallucinate frequently, but don't show signs of psychosis, like the psychics. She, like Powers and Corlett, is curious about how their experiences differ from other hallucinators based on the stigma attached to their voices—or lack thereof. In some other cultures, like the people in Ghana that Luhrmann recently visited, those who hear voices undergo extensive training to take control of them. Globally, grassroots

support groups for individuals who hear voices are becoming more common, empowering people to name their voices, share their experiences, and develop more positive relationships with the voices they hear. Intervoice, one such network based in the U.K., provides forums for people to share their stories without judgement and emphasizes auditory hallucinations as a meaningful human experience.

By framing these experiences as significant and potentially benevolent, we can help hallucinators understand and take charge of their hallucinations. “This gives us more confidence that training these hallucinations, either with neural feedback or with some kind of more spiritual training, might benefit these patients,” Luhrmann says.

Powers and Corlett hope they have also paved the way towards better diagnoses by pairing participant accounts of their experiences with computational modeling based on brain imaging. The individualized information could help psychiatrists determine the best way to treat patients based on where their symptoms and behaviors are on the psychosis spectrum.

“We can use this objective measure to show somebody, ‘Yes, you’re having these odd experiences, they’re different from the people who don’t have a need for care in these ways,’” Corlett says. Understanding these differences could also help them identify who may develop a psychotic illness and who may not.

The psychiatrists also want explore new therapies. Understanding the specific mechanisms that underlie hallucinations may help the team determine who would respond well to drugs, like those based on the cholinergic neurotransmitter system. Cholinergic neurotransmitters relate to our ability to reconsider prior expectations. These therapeutic drugs, which are based on the same active ingredient in belladonna or nightshade that can cause hallucinations, were initially rejected when they were administered broadly. But this could give researchers the means to determine who might respond well to the drugs.

Ultimately the researchers have a better understanding of “what the neural mechanisms for hallucinations in the context for mental illness might be,” Corlett says. Knowing that these symptoms exist on a spectrum, and having the tools to recognize individual differences, “can be used to treat people more effectively in the future,” Powers says.

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