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The Mesmerized Mind

Scientists are unveiling how the brain works when hypnotized

By [Susan Gaidos](#)



Mention hypnosis, and the image that springs to mind is a caped magician swinging a pocket watch, seducing otherwise sensible people into barking like dogs.

But hypnosis is more than a stage show act. For years, psychologists have used it to help patients calm preflight jitters, get a good night's sleep or chuck a cigarette habit. Hypnosis even has uses in mainstream medicine for reducing the side effects of cancer treatments and helping patients cope with pain. Some physicians routinely employ hypnosis as an adjunct to mainstream anesthesia to help block pain during surgery or childbirth.



THE MESMERIZED MIND Illustration by Lou Beach

Most recently, hypnosis has advanced from stage and clinic into the laboratory. It is now used as a research tool to temporarily create hallucinations, compulsions, delusions and certain types of seizures in the lab so that these phenomena can be investigated in detail.

Such studies may lead to more effective treatments for a number of psychiatric and neurological disorders, assert psychologists Peter W. Halligan and David Oakley in the June issue of *Trends in Cognitive Sciences*.

Other scientists, intrigued by the many practical uses of hypnosis, are striving to figure out how it works. Using the latest neuroimaging tools, these scientists are getting a look at what goes on in the hypnotized brain. The findings are mesmerizing.

When hypnotized people act on a hypnotic suggestion, they really do see, hear and feel differently, such research shows. When they're told to see colors, for example, the color-processing parts of their brains light up—despite the absence of any real color in view. When they are told to envision color objects in black and white, these color-processing areas are less active. Other imaging studies show that hypnotically induced pain activates the same brain areas as “real” pain.

Over the past few years, scientists have begun gathering evidence that hypnosis can indeed measurably change how the brain works.

Still, questions remain, says Halligan, of Cardiff University in Wales, who has studied hypnosis for more than a decade. Scientists have yet to discover how hypnosis produces physiological changes. And some scientists question whether such changes are confined to hypnosis. Perhaps the patterns of brain activity seen during hypnosis can occur during everyday experiences when people are fully absorbed in an activity, some researchers say.

The real question, says Halligan, is whether hypnosis is a specific brain state that differs from any other.

“In other words, is there some sort of neural correlate, or biological marker, within the brain during a hypnotic trance?” he asks.

The answer so far, emerging from studies done during the past few years, is

maybe. New research at the University of Geneva suggests that hypnosis alters neural activity by rerouting some of the usual connections between brain regions. Such neurological detours don't happen when subjects merely imagine a scenario.

Changing your mind

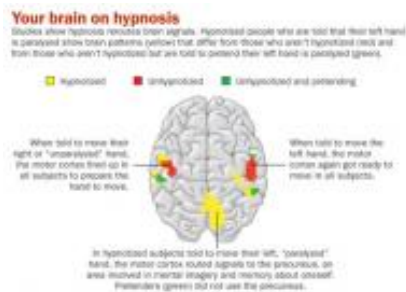
Hypnosis got its start as a “miracle cure” in 1774 when physician Franz Mesmer found a way, using ethereal music played on a glass harmonica, to induce a hypnotic trance in patients suffering from various unexplained medical problems. Though eventually discredited as a healer, Mesmer demonstrated that the mind could be manipulated by suggestion to produce an effect in the body. So powerful is this effect that the practice was resurrected in the 19th century, before the discovery of ether, to block pain during major surgeries.

In this mysterious state of mind, the brain is “quiet,” focused and superattentive. People sometimes report feeling disconnected from their surroundings and lost in thought. During hypnosis, subjects are more open than usual to suggestions and have the ability to focus intensely on a specific thought, feeling or sensation.

Most adults, about two-thirds, are hypnotizable to some degree, though some people experience the effects of hypnosis more intensely than others do, says David Spiegel, a psychiatrist at Stanford University School of Medicine who uses hypnosis in his medical practice. Ten to 15 percent of adults are “highly hypnotizable,” he says, meaning they can experience dramatic changes in perception with hypnosis.

A person's ability to become hypnotized is unrelated to intelligence, compliancy or gullibility, but may be linked to an ability to become deeply absorbed in activities such as reading, listening to music or daydreaming. People who find themselves engrossed in a best seller even while the television is blaring, or swept away by a movie and losing track of time, are likely to be quite hypnotizable.

During hypnosis, the hypnotherapist tries to direct thoughts, feelings and behavior by instructing a person to concentrate on particular images or ideas. A typical session starts with some sort of induction procedure that helps the subject relax—say, counting down from 20 to one or mentally descending a set of stairs.



YOUR BRAIN ON HYPNOSIS - Studies show hypnosis reroutes brain signals. Hypnotized people who are told that their left hand is paralyzed show brain patterns (yellow) that differ from those who aren't hypnotized (red) and from those who aren't hypnotized but are told to pretend their left hand is paralyzed (green). Y. Cojan Et al./Neuron 2009

To produce a specific behavior or thought, the hypnotherapist will make suggestions targeted toward the goal. To reduce the pain of a medical procedure, for example, a hypnotherapist might invoke an image of pain being turned down like the volume on a radio.

Over the years, rigorously controlled studies have shown that hypnosis can also control blood pressure and even make warts go away. But because very few studies have attempted to find out how it works, some scientists are still skeptical of its power.

Critics suggest hypnosis is nothing more than playacting, with subjects trying to please the hypnotist. That skepticism has driven some researchers to take a hard look at what happens in the brain during hypnosis. Over the past few years, scientists have begun gathering evidence that hypnosis can indeed measurably change how the brain works.

In 2005, scientists at Weill Medical College of Cornell University in New York City used functional MRI to show how hypnotic suggestions can override “automatic” processes in the brain. When shown the names of colors printed in different colors of ink—for example, the word *red* printed in blue—subjects were instructed to name the ink color while ignoring the word.

Though this task may sound easy, it’s often difficult for people who can read because the tendency is to automatically read the word instead of naming the color. When told under hypnosis that the words would appear as gibberish, highly hypnotizable subjects were able to perform the task faster, and with fewer errors, than subjects who were less hypnotizable and therefore less likely to respond to suggestion.

The fMRI results were also striking. Highly hypnotizable participants showed less activity in a brain area called the anterior cingulate cortex, which is active when people are trying to sort out conflicting information from different sources, such as contradictory word names and colors. The study was published in the *Proceedings of the National Academy of Sciences*.

Going deeper

Scientists agree that there is a pattern or “orchestra” of brain activity during hypnosis. Halligan and his colleagues are working to figure out what this particular pattern might be, and which—if any—brain region serves as conductor. As part of a collaboration with psychiatrist Quinton Deeley of King’s College London, the researchers are looking at how patterns of brain activity in the induction phase—the countdown—prepare the brain for suggestions.

Preliminary findings suggest that hypnosis boosts activity in the brain’s prefrontal cortex—a region responsible for various executive functions such as decision making and regulating attention—while suppressing activity in other brain regions.

THE EYE-ROLL TEST - Some researchers and hypnotists use a simple eye-roll test to get an idea of how hypnotizable people are. If more white, or sclera, shows when a person looks up (bottom), he or she is more likely to be susceptible to hypnosis. T. Dube, adapted from Powerlines/Istockphoto



Still, researchers are stumped to explain how these changes in brain patterns work to make hypnotized people feel and see things differently. Recent theories, discussed in the article in *Trends* by Halligan and Oakley, of University College London, propose that hypnotic suggestions may inhibit or disconnect certain mental processes from the brain’s executive control systems.

Until recently, such hypotheses had remained untested. But in the June 25 issue of *Neuron*, Yann Cojan of the University of Geneva and colleagues report a direct test.

The researchers put 18 subjects in a brain scanner, instructing them to push a button using one hand or the other. Each trial began with a cue indicating which hand to prepare for movement. After a brief interval, an image of a hand would turn green—signaling to press the button—or red, a command to inhibit any motion. Twelve subjects did half of the trials while hypnotized, with the suggestion that their left hand was “paralyzed,” and the other half in a normal, un hypnotized state. Six subjects did trials without hypnosis under instructions to pretend their left hand was paralyzed.

When volunteers used their right hands, the motor cortex linked up with brain regions that control body movement to carry out the task.

But fMRI scans showed changes in several brain areas when hypnotic paralysis prevented subjects from responding to the “go” signal with their left hands. Under hypnosis, neurons in the brain’s motor cortex fired up as usual to prepare for the task. But when instructed to use the left, or “paralyzed”

hand, the motor cortex failed to send signals to motor execution regions. Instead, it directed its signals to another brain region, the precuneus.

The precuneus is a sort of center for self-consciousness. If you've ever pictured yourself falling flat on your face in the middle of an important event, that's your precuneus working overtime. Its function is to help retrieve memories and images of yourself from the brain's archives and help to visualize movements.

By rerouting motor signals to the precuneus, hypnosis appeared to decouple the typical relationship between brain areas that generate the signals for hand movement and the areas that carry out such movements. Subjects who were not hypnotized and were asked to fake paralysis showed no such disconnect between these regions.

Because the precuneus is involved in mental imagery and self-awareness, Cojan says, hypnosis appeared to enhance the brain's self-monitoring processes to allow images generated by suggestion—"your hand is heavy and cannot move"—to guide behavior.

By linking to the precuneus, "the motor cortex is connected to the *idea* that it cannot move the left hand," Cojan says. "So even if you try to move, it will neglect to send signals to the motor execution areas."

Because the motor cortex fired up as usual to prepare for the task, the findings suggest that mental images created through hypnotic suggestions work by redirecting normal brain functions rather than actively suppressing them, he adds.

Generating piece of mind

Using insights gleaned from the brain scans of subjects paralyzed under hypnosis, Cojan conducted a follow-up study to see whether something like hypnosis happens in the brains of patients during hysterical paralysis. In such instances, patients become paralyzed even though the condition can't be traced to any physical or neurological brain damage.

An fMRI study of patients with hysterical hand paralysis did not find the heightened precuneus activity that is seen in hypnosis, Cojan's group reported in the September *NeuroImage*.

Previously, it had been suggested that hysterical paralysis was "a kind of self-hypnosis," Cojan says. "Our findings show that's not the case."

Halligan points to the recent paralysis studies as examples of how hypnosis can be used to further studies on the nature of hypnosis and to provide insights on a variety of real-life syndromes and disorders.

In 2000, he and Oakley began looking at ways to use hypnosis to simulate psychosomatic conditions, such as hysterical paralysis or hysterical blindness, in the lab. By creating virtual patients through hypnosis, scientists might be able to better understand the basis for such disorders by comparing patients' brains with hypnotized brains, the researchers reckoned.

Deeley, who treats psychiatric patients at his private practice in London, says using hypnosis also allows him to track brain processes involved in other kinds of disorders that would not ordinarily be possible to study with brain imaging.

In an ongoing series of experiments, he and his colleagues are using hypnosis to study conditions in which patients sense a "lack of control" over their movements or behavior. Such perceptual experiences may be reported by people who experience nonepileptic seizures or who suffer delusions caused by schizophrenia.

By making some targeted suggestions—"Your left hand is now shaking at your side" or "Your right leg is twitching"—the scientists can model a particular symptom in a consistent and controlled way, Deeley says.

“You can’t have somebody having a full-blown seizure within an MRI scanner,” he says. “It’s not safe because they’re moving fast, and you wouldn’t get any useful information. But if you actually restrict an involuntary movement to a particular limb or a hand, it is possible to create a partial model of these involuntary movements.”

Another advantage of hypnosis is that it allows researchers to untangle the many components that make up a complex disorder, such as schizophrenia. In such cases, patients may feel not only that they’re losing control, but also that their actions or behavior are guided by an outside force or agent, such as the CIA.

Scientists then have the problem of sorting out whether a change in brain activity is associated with the physical experience of a movement or whether it is tied to the delusional beliefs behind the movement.

“In such cases, you’ve got two processes going on associated with complex change in brain activity, and you just can’t unpack them in terms of working out what’s associated with what,” Deeley says.

Experimental manipulations using hypnosis could provide a window into a wide range of disorders, he says, and could help explain other types of altered states, such as meditation.

Halligan agrees, noting that hypnosis could be used to simulate various disorders commonly associated with brain injury, such as visual impairment. In a recent study, he used hypnotic suggestions to replicate conditions described by injured soldiers who are still capable of detecting motion in certain visual fields but are unable to make out any distinguishing features of the moving object.

“That’s not to say that the same psychological consequences of pathology seen in patients are somehow replicated in hypnosis,” Halligan says. “But using hypnosis to simulate a specific condition for imaging may tell us which brain systems are involved.” This information may then feed back into the development of new treatments and rehabilitation tools, he says.

Such advancements, however, hinge on learning more about the underlying processes involved in hypnosis itself. Current efforts may help scientists differentiate between the brain structures that play a role in hypnosis and those that are involved in the tasks subjects are asked to perform.

“These are still early days,” Halligan says, noting that it has yet to be seen how well hypnotically simulated disorders will actually match the conditions they’re intended to mimic. Still, he says, hypnosis provides a way to “test and probe.”

Best of all, no pocket watches are involved.

Susan Gaidos is a freelance science writer based in Maine.

Citations & References:

- Explore the science behind hypnosis at the Hypnosis and Suggestion website: www.hypnosisandsuggestion.org
- Spiegel, D. 2007. The mind prepared: Hypnosis in surgery. *Journal of the National Cancer Institute* 99(Sep 5):1280-1281.
- Raz, A., et al. Hypnotic suggestion reduces conflict in the human brain. *Proceedings of the National Academy of Sciences* 102(July 12):9978–9983.
- Oakley, D. A. and Halligan, P. W., 2008. Hypnotic suggestion and cognitive neuroscience. *Trends in Cognitive Sciences* 13(June 6):264-270. doi:10.1016/j.tics.2009.03.004
- Cojan, Y., et al. 2009. The brain under self-control: Modulation of inhibitory and monitoring cortical networks during hypnotic paralysis. *Neuron* 62(June 25):862-875.
- Cojan, Y., et al. 2009. Motor inhibition in hysterical conversion paralysis. *NeuroImage* 47(September):1026-1037.