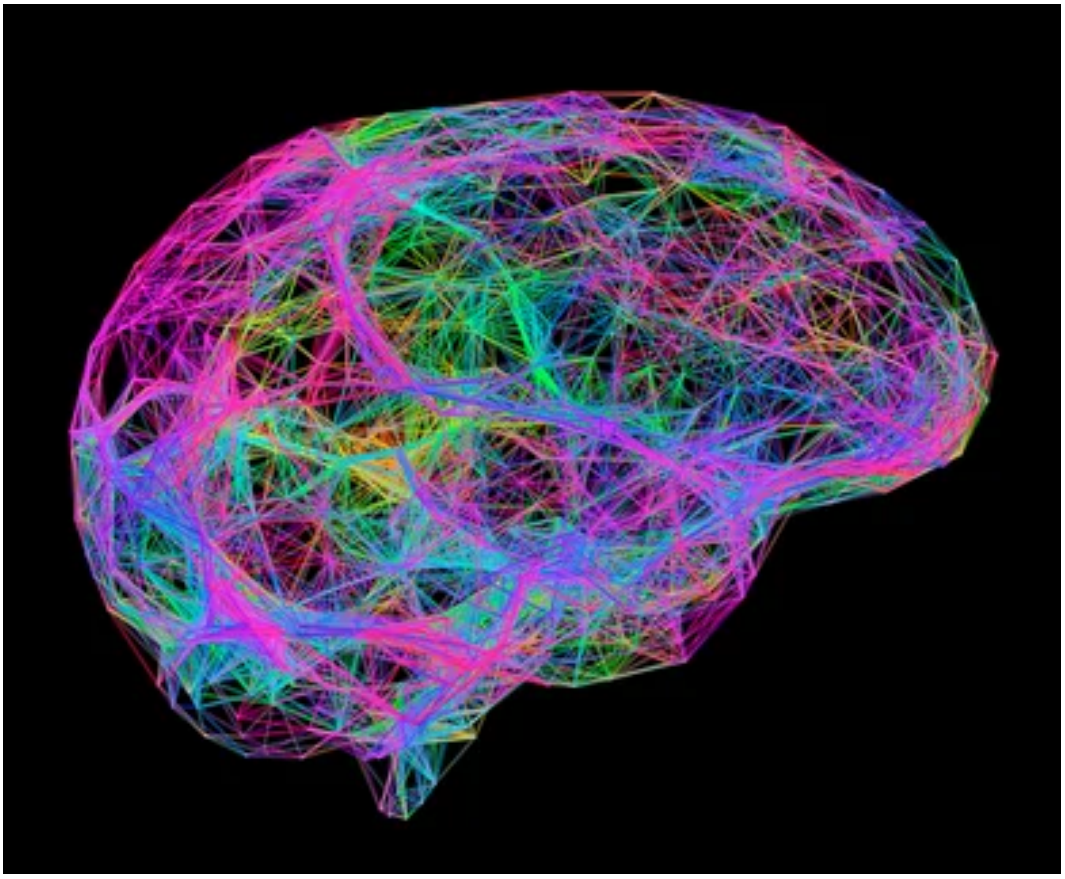
Observations
| Opinion

Mind Reading and Mind Control Technologies Are Coming

We need to figure out the ethical implications before they arrive

By R. Douglas Fields on March 10, 2020



Credit: Alfred Pasieka *Getty Images*

The ability to detect electrical activity in the brain through the scalp, and to control it, will soon transform medicine and change society in profound ways. Patterns of electrical activity in the brain can reveal a person's cognition—normal and abnormal. New methods to stimulate specific brain circuits can treat neurological and mental illnesses and control behavior. In crossing this threshold of great promise, difficult ethical quandaries confront us.

MIND READING

The ability to interrogate and manipulate electrical activity in the human brain promises to do for the brain what biochemistry did for the body. When you go to the doctor, a chemical analysis of your blood is used to detect your body's health and potential disease. Forewarned that your cholesterol level is high, and you are at risk of having a stroke, you can take action to avoid suffering one. Likewise, in experimental research destined to soon enter medical practice, just a few minutes of monitoring electrical activity in your brain using EEG and other methods can reveal not only neurological illness but also mental conditions like ADHD and schizophrenia. What's more, five minutes of monitoring electrical activity flowing through your brain, while you do nothing but let your mind wander, can reveal how your individual brain is wired.

Tapping into your wandering mind can measure your IQ, identify your cognitive strengths and weaknesses, perceive your personality and determine your aptitude for learning specific types of information. Electrical activity in a preschooler's brain be used to can predict, for example, how well that child will be able to read when they go to school. As I recount in my new book, *Electric Brain* (BenBella, 2020), after having brainwaves in my idling mind recorded using EEG for only five minutes, neuropsychologist Chantel Prat at the University of Washington, in Seattle, pronounced that learning a foreign language would be difficult for me because of weak beta waves in a particular part of my cerebral cortex processing language. (Don't ask me to speak German or Spanish, languages that I studied but never mastered.) How will this ability to know a person's mind change education and career choices?

Neuroscientist Marcel Just and colleagues at Carnegie Mellon University are using fMRI brain imaging to decipher what a person is thinking. By using machine learning to analyze complex patterns of activity in a person's brain when they think of a specific number or object, read a sentence, experience a particular emotion or learn a new type of information,

the researchers can read minds and know the person's specific thoughts and emotions. "Nothing is more private than a thought," Just says, but that privacy is no longer sacrosanct.

Armed with the ability to know what a person is thinking, scientists can do even more. They can predict what a person might do. Just and his team are able to tell if a person is contemplating suicide, simply by watching how the person's brain responds to hearing words like "death" or "happiness." As the tragic deaths of comedian Robin Williams and celebrity chef Anthony Bourdain show, suicide often comes as a shock because people tend to conceal their thoughts of suicide, even from loved ones and therapists.

Such "brain hacking" to uncover that someone is thinking of suicide could be lifesaving. The technique applied to the Columbine high school mass murderers might have prevented the horror of two troubled teens slaughtering their classmates and teachers, as well as their own suicides. But this insight into suicidal ideation is gleaned by judging that the pattern of brain activity in an individual's brain deviates from what is considered "normal" as defined as the average response from a large population. At what point do we remove a person from society because their brain activity deviates from what is considered normal?

MIND CONTROL

The ability to control electrical activity in brain circuits has the potential to do for brain disorders what electrical stimulation has accomplished in treating cardiac disorders. By beaming electrical or magnetic pulses through the scalp, and by implanting electrodes in the brain, researchers and doctors can treat a vast array of neurological and psychiatric disorders, from Parkinson's disease to chronic depression.

But the prospect of "mind control" frightens many, and brain stimulation to modify behavior and treat mental illness has a sordid history. In the 1970s neuropsychologist Robert Heath at Tulane University inserted electrodes into a homosexual man's brain to "cure" him of his homosexual nature by stimulating his brain's pleasure center. Spanish neuroscientist José Delgado used brain stimulation in monkeys, people and even a charging bull to understand how, at a neural circuit level, specific behaviors and functions are controlled—and to control them at will by pushing buttons on his radio-controlled device energizing electrodes implanted in the brain. Controlling movements, altering thoughts, evoking memories, rage and passion were all at Delgado's fingertips. Delgado's goal was to relieve the world of deviant behavior through brain stimulation and produce a "psychocivilized" society.

The prospect of controlling a person's brain by electrical stimulation is disturbing for many, but current methods of treating mental and neurological disorders are woefully inadequate and far too blunt. Neurological and psychoactive drugs affect many different neural circuits in addition to the one targeted, causing wide-ranging side effects. Not only the brain but

every cell in the body that interacts with the drugs, such as SSRIs for treating chronic depression, will be affected.

At present, drugs available for treating mental illness and neurological conditions are not always effective, and they are often prescribed in a trial-and-error manner. Psychosurgery, notoriously prefrontal lobotomy, also has a tragic history of abuse. Moreover, while any surgeon faces the prospect of losing the patient on the operating table, neurosurgeons face the unique risk of saving a patient's life but losing the person. Surgical removal of brain tissue can leave patients with physical, cognitive, personality or mood dysfunctions by damaging healthy tissu, or failing to remove all the dysfunctional tissue. Electroconvulsive stimulation (ECT), to treat chronic depression and other mental illnesses, rocks the entire brain with seizure; in the wake of the electrical firestorm, the brain somehow resets itself, and many patients are helped, but not all, and sometimes there are debilitating side effects or the method fails to work.

Rather than blasting the whole brain with bolts of electricity or saturating it with drugs, it makes far more sense to stimulate the precise neural circuit that is malfunctioning. Following the success of deep brain stimulation in treating Parkinson's disorder, doctors are now applying the same method to treat a wide range of neurological and psychiatric illnesses, from dystonia to OCD. But they are often doing so without the requisite scientific understanding of the disorder at a neural circuit level. This is especially so for mental illnesses, which are poorly represented in nonhuman animals used in research. How electrical stimulation is working to help these conditions, including Parkinson's disease, is not fully understood. The necessary knowledge of where to put the electrodes or what strength and pattern of electrical stimulation to use is not always available. Such doctors are in effect doing experiments on their patients, but they are doing so because it helps.

Noninvasive means of modifying brainwaves and patterns of electrical activity in specific brain circuits, such as neurofeedback, rhythmic sound or flashing light, ultrasonic and magnetic stimulation through the scalp, can modify neural activity without implanting electrodes in the brain to treat neurological and mental illnesses and improve mood and cognition. The FDA approved treating depression by transcranial magnetic stimulation in 2008, and subsequently expanded approval for treating pain and migraine. Electrical current can be applied by an electrode on the scalp to stimulate or inhibit neurons from firing in appropriate brain regions.

The military is using this method to speed learning and enhance cognitive performance in pilots. The method is so simple, brain stimulation devices can be purchased over the internet or you can make one yourself from nine-volt batteries. But the DIY approach renders the user an experimental guinea pig.

New methods of precision brain stimulation are being developed. Electrical stimulation is notoriously imprecise, following the path of least resistance through brain tissue and stimulating neurons from distant regions of the brain that extend axons past the electrode. In experimental animals, very precise stimulation or inhibition of neuronal firing can be achieved by optogenetics. This method uses genetic engineering to insert light sensitive ion channels into specific neurons to control their firing very precisely using laser light beamed into the brain through a fiberoptic cable. Applied to humans, optogenetic stimulation could relieve many neurological and psychiatric disorders by precision control of specific neural circuits, but using this approach in people is not considered ethical.

CROSSING THE THRESHOLD

Against the historical backdrop of ethical lapses and concerns that curtailed brain stimulation research for mental illnesses decades ago, we are reaching a point where it will become unethical to deny people suffering from severe mental or neurological illness treatments by optogenetic or electrical stimulation of their brain, or to withhold diagnosing their conditions objectively by reading their brain's electrical activity. The new capabilities of being able to directly monitor and manipulate the brain's electrical activity raise daunting ethical questions from technology that has not existed previously. But the genie is out of the bottle. We better get to know her.

ABOUT THE AUTHOR(S)

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Credit: Nick Higgins

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