Can Electrical Stimulation Better Brain Function in Humans?

A potential treatment for certain mental disorders involves zapping a certain area of the brain with short bursts of electrical energy.

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Since deep brain stimulation (DBS) was approved by the Food and Drug Administration (FDA) as a treatment tool, doctors have used the surgical procedure to treat neurological conditions in more than 160,000 people. Now, recent study findings published in the journal Nature Biomedical Engineering show that it might be possible to use DBS along with artificial intelligence to improve functions in the brain linked to cognitive control of thought and behavior, reports a press release from the University of Minnesota (U of M) Medical School.

For the study, two researchers—one from U of M and the other from Massachusetts General Hospital—teamed for an inquiry that involved 12 participants undergoing brain surgery for epilepsy. Called intracranial epilepsy monitoring, the procedure involves placing hundreds of tiny electrodes throughout the brain to observe the organ's activities and determine the origination points of seizures.

During the procedure, scientists identified a region of the brain called the internal capsule that supervises people's cognitive control and also helped to improve patients' mental function in response to small amounts of electrical energy stimulation.

Responsible for cognitive control—the ability to shift from one thought or behavior to another—the internal capsule sustains damage in most mental illnesses.

"An example might include a person with depression who just can't get out of a 'stuck' negative thought," explained Alik Widge, MD, PhD, an assistant professor of psychiatry and member of the medical discovery team on addiction at the medical school and the study's senior author. "Because it is so central to mental illness, finding a way to improve it could be a powerful new way to treat those illnesses."

Widge and his colleague from Massachusetts General, Darin Dougherty, MD, created algorithms to track patients' capacity to control cognitive abilities—by participants' actions and brain activity—after stimulation of their internal capsule region.

“This system can read brain activity, ‘decode’ from that when a patient is having difficulty and apply a small burst of electrical stimulation to the brain to boost them past that difficulty,” explained Widge. “The analogy I often use is an electric bike. When someone’s pedaling but having difficulty, the bike senses it and augments it. We’ve made the equivalent of that for human mental function.”

Widge described what’s known in science as a closed-loop algorithm, which adapts to and controls a patient’s mental state. Some participants experienced a lot of anxiety along with their epilepsy. But when scientists administered electrical stimulation, individuals confirmed that they felt less distressed and better able to focus on other things.

This could be a new approach to treat mental illness. “Instead of trying to suppress symptoms, we could give patients a tool that lets them take control of their own minds,” Widge said. “We could put them back in the driver’s seat and let them feel a new sense of agency.”

Currently, the research team is preparing to study new tests and treatments that utilize tools and devices the FDA already approved for DBS.

“The wonderful thing about these findings is that we are now in a position to conduct clinical trials to further demonstrate [the] effectiveness [of deep brain stimulation] and then hopefully move to helping treatment-resistant patients who are in desperate need for additional interventions to treat their illnesses,” Dougherty said.

To learn more about how DBS is used to treat certain brain disorders, read “Inside Muhammad’s Final Fight With Parkinson’s Disease.”
