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Brain Training for Anxiety, Depression and Other Mental Conditions

Neurofeedback uses real-time scans to teach patients to try to change how they think



Images of faces superimposed on scenes were used in a study of neurofeedback for depressed patients at the University of Texas at Austin to train patients to disengage from negative stimuli. *PHOTO: PRINCETON NEUROSCIENCE INSTITUTE, PRINCETON UNIVERSITY*

By **ANDREA PETERSEN**

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A new treatment for psychiatric disorders like depression and anxiety uses real-time scans to show patients how their brains go awry—and how to fix the dysfunction.

The treatment is called neurofeedback.

There is an urgent need for new approaches for psychiatric disorders, particularly depression. Almost 17% of Americans will suffer from major depression during their lifetime, according to a 2012 study published in the

International Journal of Methods in Psychiatric Research.

Not everyone responds to current treatments like antidepressant medication and talk therapy. In one study of almost 3,000 patients, only about 1/3 of them achieved remission from their depression after up to 14 weeks on the drug citalopram (brand name Celexa).



An fMRI scan from a participant in a study using neurofeedback for spider phobia. The study targeted activity in part of the insula, a brain region implicated in sustained anxiety. It is at the center of the white cross. *PHOTO: ANNA ZILVERSTAND, ICAHN SCHOOL OF MEDICINE AT MOUNT SINAI*

Neurofeedback aims to be more precise than current therapies. It directly targets the brain dysfunctions and emotional and cognitive processes that are understood to underlie psychiatric disorders. Doctors hope that treatments could also be personalized to address the issues in each individual's brain.

Besides depression, neurofeedback is being studied in phobias, obsessive-compulsive disorder, addiction, traumatic brain injury and chronic pain, among other illnesses.

With neurofeedback, “there’s no need to take medication and no need to talk about your mother to a stranger,” says Kymberly Young, a postdoctoral associate at the Laureate Institute for Brain Research in Tulsa, Okla.

In neurofeedback, patients lie in a functional magnetic resonance imaging scanner. In general, they are told to conjure memories or look at pictures while

their brains are scanned. The activity of certain brain regions related to subjects' illnesses is analyzed via computer. Patients see visual representations of their brain activity almost in real time—often presented in the form of a thermometer or colored bar.

Based on what their brains are doing, subjects are told to enhance or suppress that activity. Patients “need to train their brain like they train their muscles when they want to be fit,” says Anna Zilverstand, a postdoctoral researcher at the Icahn School of Medicine at Mount Sinai in New York and lead author of a 2015 study using neurofeedback to treat women with a phobia of spiders.



A study on neurofeedback for women with spider phobia used a series of pictures that became increasingly scary, clockwise from top left. PHOTO: PHOTO ILLUSTRATION/MAASTRICHT UNIVERSITY

The science on neurofeedback for psychiatric disorders is in its early days. So far, studies are very small and researchers are still figuring out which brain areas to target and how many sessions to try. Results are modest and it is unclear how long the effects of the treatment last. Also, fMRI scans are expensive, costing hundreds of dollars. Some researchers believe that neurofeedback will most likely be used in addition to current medications and talk therapies.

Dr. Young led a study of 23 depressed patients published in 2014 in the journal Plos One. In it, those who received one session of active neurofeedback for their illness saw their scores on a measure of happiness increase significantly more than those in a control group.

The happiness scores in the active group jumped 20%; the control group went up just 2%. Depression scores and an anxiety measure also dropped after treatment.

But depression also dropped among those in the control group, and the difference in the drop between the groups wasn't statistically significant.

In results from a more recent study, Dr. Young says that after two sessions of neurofeedback, depression scores dropped 50%. In the control group, they dropped 10%. These results are not yet published, but were presented at the Society of Biological Psychiatry annual meeting in 2015.

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Neurofeedback didn't work for everyone: About 10% of depressed participants had normal amygdala activity at the beginning of the studies. Another 10% of participants couldn't learn how to regulate the amygdala.

While in the scanner, study subjects were told to recall positive autobiographical memories. At the same time, they were shown an image of a red bar, which coordinated with their own brain activity. Subjects in the active group received feedback from their left amygdala, a part of the brain that processes emotional memories.

The amygdala generally isn't as active in depressed patients when they think of positive autobiographical events. The level of blunting correlates with the severity of symptoms. The control group also received feedback, but from a part of the brain involved in processing numbers and unrelated to depression. Subjects were then told to make the red bar rise.

Beyond recalling happy memories, subjects weren't given specific strategies on what to do to boost activity. But Dr. Young says that for women, thinking about childbirth or playing with pets boosted amygdala activity the most. For men, pondering thrilling pursuits like sky diving and sex led to the biggest rises.

Zac Williams recently participated in two of the Tulsa neurofeedback studies for depression. "I was going through a tough time. My father had just died and my girlfriend broke up with me," says the 26-year-old phone repair technician from Tulsa.

While he was in the scanner and trying to get the red bar to rise, researchers told him to pick several happy memories. He said he thought of getting his first car, a camping trip with friends and his first time riding a motorcycle. But those memories, he said, “weren’t necessarily making the bar go up.” So he tried thinking about funny movies. When he recalled scenes of “Dumb and Dumber,” he says the bar spiked. “It was kind of crazy to see something react based on your thoughts.”



Zac Williams, 26, participated in two studies of neurofeedback for depression in Tulsa, Okla. *PHOTO: ZAC WILLIAMS*

Since the treatment, Mr. Williams says his mood has improved. He says he’s also using the skills he learned in the scanner when he feels down. “If there is something that bogs me down, I try to find a way to make myself laugh,” he says.

While fMRI neurofeedback is only a few years old, its principles have been around for decades. Doctors and researchers have long used electroencephalograms (EEG), tests that record electrical activity, to perform a version of neurofeedback. The approach is particularly popular as a treatment for ADHD in children.

But there are drawbacks with EEG. It is much less precise in targeting brain areas than fMRI, says David Linden, a psychiatrist and professor of translational neuroscience at Cardiff University in Wales who has studied the use of fMRI neurofeedback in depression. In a 2012 study of his, depressed patients saw their symptoms drop by 30% after four sessions of neurofeedback.

Researchers at the University of Texas at Austin are trying a novel approach.

Instead of displaying feedback as a chart or temperature gauge, they are using pictures that change based on subjects' brain activity. Depressed patients tend to have what is known as a negative attention bias: They pay more attention to negative stimuli and have a harder time disengaging from it. The goal of the neurofeedback training is to get depressed patients to disengage from the negative.

In a small pilot study without a control group, depressed patients were shown a series of images while in the scanner. In each one, a sad face was superimposed on a neutral scene, of a living room, for example. Patients were told to focus on the scenes and ignore the faces.

Because emotional stimuli like faces activate certain parts of the brain, the fMRI scan could distinguish what the subjects paid attention to. The image was then changed based on the subjects' brain activity: The more they paid attention to the scenes, the fainter the faces appeared. Seven depressed adults had three sessions of neurofeedback in a five-day period. Depression symptoms continued to improve during the following month.

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