Neurofeedback increases self-esteem by rebalancing brain circuits in depression

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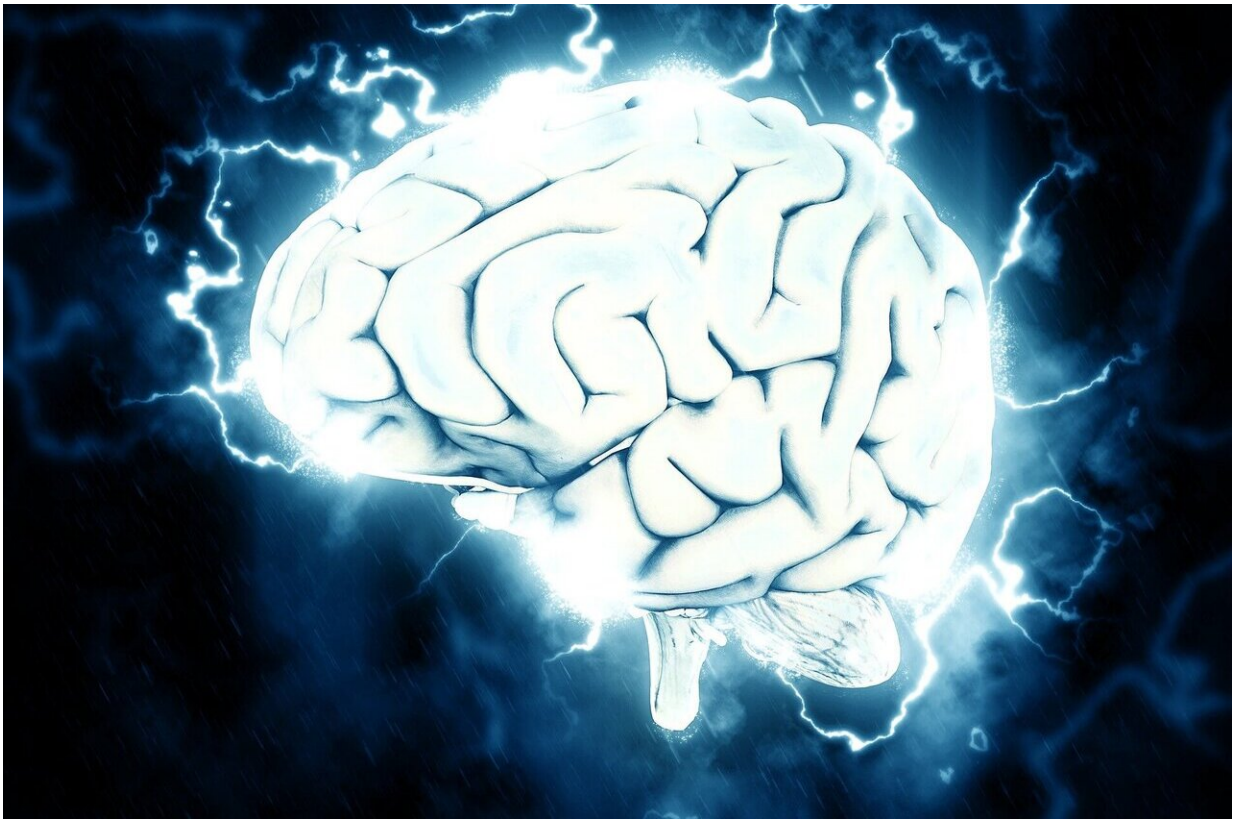

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A study published in the journal *Neuroimage: Clinical* found that patients with Major Depressive Disorder (MDD), who had recovered from symptoms, were able to strengthen some of their brain connections

whilst thinking about guilt-evoking memories, thereby increasing their self-esteem. The research showed that connectivity between certain brain regions—previously found to be decreased when feeling guilt in people with a history of depression—could be strengthened in a single session of neurofeedback training through functional magnetic resonance imaging (fMRI), captured before and after the procedure. The study was conducted by the Brazilian organizations D"Or Institute for Research and Education (IDOR), Federal University of Rio de Janeiro (UFRJ) and Federal University of ABC, in collaboration with King's College London, in the United Kingdom.

Major Depressive Disorder (MDD), also known as depression, is a mental disorder caused by a set of social, psychological and biological factors. Its symptoms are characterized by the continuous loss of interest and pleasure in daily life and the prevalence of negative feelings such as low mood, self-blame, and low self-esteem. According to data from the World Health Organization (WHO), last year, depression already affected more than 300 million people in the world, becoming the most disabling disease of contemporary times. Considering the seriousness of the problem in global public health, the medical and scientific communities are increasingly seeking to understand the depressive disorder, aiming at the development of new therapies and improvement of patients' quality of life.

Studying MDD through fMRI—a technique that allows researchers to analyze brain structure and function in a noninvasive way—the recently published paper was based on the scientific finding that people with depression, even when recovered from symptoms, showed less connectivity between two specific brain areas while experiencing feelings of guilt: the right anterior superior temporal (ATL) and the anterior subgenual cingulate (SCC). By connectivity, the study refers to the exchange of information between these structures, as they are directly linked to the interpretation of social interactions.

Based on this "neural signature" on patients' brains, the study tested the possibility of strengthening these connections through neurofeedback, a program that allows participants to observe and modify their brain activities in real-time. Although at the early stages, the result was quite remarkable: in just one training session, participants already demonstrated a stronger connection between the mentioned areas and reported an increase in self-esteem after the neurofeedback interaction.

How the research was done?

The study's first author, Dr. Roland Zahn at King's College London, explains why the study was carried out in people who had recovered from symptoms: "The brain signature of excessive self-blame was discovered in patients with Major Depressive Disorder whose symptoms had remitted, suggesting it could precede the symptoms of depression, making people more vulnerable to the disorder. Secondly, for safety reasons we wanted to make sure people's depression wouldn't get worse after the treatment, and people with remitted MDD are less at risk to worsen significantly than people with current symptoms."

To conduct the research, the 28 participants with remitted depressive symptoms were randomly divided into two groups. One group was exposed to a control neurofeedback exercise where they had to maintain the same level of their brain connections, while the other group was instructed to increase these connections during training. This procedure was accomplished through visual feedback on a screen that indicated if people were doing the brain exercise in the instructed way. "The participants had to imagine a specific memory from their past which made them feel guilt or indignation towards others. On the screen, they had to change the way they felt about this so that the color display that reflected their brain connections would also change. The marker was a thermometer that, when filled to the top, would be a signal that the participants were doing well in the training," explains the first author.

Although neurofeedback exposure time was the same in both groups, in the fMRI results, participants who were instructed to increase activity on their brain wirings showed strengthening in the connectivity between the exercised areas. At the same time, it was observed an increase in their self-esteem that wasn't found in the group that kept their connections at the same initial level, results that proved the effectivity of the training.

The study also required the development of a specific neurofeedback software, the "Functional Real-Time Interactive Endogenous Neuromodulation and Decoding," or simply, FRIEND. Dr. Jorge Moll, a neuroscientist at IDOR and corresponding author of the study, led the group who created the program. "FRIEND is a toolbox developed for any kind of neurofeedback study using fMRI. The current implementation geared towards this aspect of MDD pathophysiology, but other designs, cognitive states, emotions, and patient populations can also be targeted in future researches," he explained.

At IDOR, Dr. Moll has conducted other studies involving the induction of brain wiring changes through neurofeedback training. For him, fMRI is one of the most powerful tools for noninvasively analyzing brain functions, but clinical applications related to neurofeedback are still at an early stage. "There is a road ahead. We need to establish the pathophysiology, side effects, therapeutic effects, and ideal target patient populations, as well as cost-effectiveness. Despite fMRI time being expensive, it is not much more than other treatments, and this can potentially offer an alternative for patients who are poor responders to conventional therapies. Yet, lots of fundamental research needs to be done, but potential clinical applications are starting to emerge."

Intending to allow further research development on the area, Dr. Jorge Moll informs that the neurofeedback software, FRIEND, is available online for free, accessible to any other interested researchers. Its use is not limited to the current study scope and can be applied more widely in

neurofeedback research. Authors inform that this research is the first step in developing a novel treatment for recurrent depression, but it was not intended to prove the efficacy of this approach, which will need to be investigated in future larger studies with longer follow-up observations.

More information: Roland Zahn et al, Blame-rebalance fMRI neurofeedback in major depressive disorder: A randomised proof-of-concept trial, *NeuroImage: Clinical* (2019). DOI: 10.1016/j.nicl.2019.101992

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