August 2025

Q: What is neurofeedback?

A: Neurofeedback is a biofeedback approach in which individuals' brain activity is measured and conveyed in real-time to teach them volitional control of specific brain activity (Nicholson et al., 2020; Sitaram et al., 2017). This brain activity is presented as a visual and/or auditory signal that the individual attempts to modulate (Papo, 2019). Neurofeedback modalities, which include electroencephalography (EEG) and functional magnetic resonance imaging (fMRI), are non-invasive and used to address issues such as attention deficit hyperactivity disorder (ADHD), epilepsy, and depression (Papo, 2019). Recently there has been interest in applying neurofeedback to treat posttraumatic stress disorder (PTSD; Askovic et al., 2023).

Q: What is the potential mechanism of action underlying neurofeedback for PTSD?

A: Neurofeedback approaches are based on two main concepts: learning via operant conditioning, which states behavior can be changed through consequences (reinforcements and punishments), and neuroplasticity, which describes the process of forming new neural connections due to learning (Orndorff-Plunket et al., 2017; Papo, 2019). Specifically, individuals learn which cognitive, affective, or behavioral processes are linked to specific brain activity and then are trained to engage in adaptive behaviors to form or strengthen neural activity that correspond to improved cognitive, affective, or behavioral outcomes. Multiple neurofeedback protocols have been investigated for use in the treatment of PTSD. For instance, studies using EEG neurofeedback revealed normalization of dysregulated alpha rhythms, which are associated with various PTSD symptoms related to emotion dysregulation (Nicholson et al., 2020; Nicholson et al., 2023). In addition, fMRI neurofeedback has been shown to attenuate hyperactive amygdala responses to fear and anxiety inducing stimuli, a common feature of PTSD (Zhao et al., 2023). However, more evidence is needed to establish the reliability and treatment specificity of these neural changes. Overall, neurofeedback for PTSD aims to help individuals restore dysregulated brain activity and connectivity with the goal of improving emotion regulation and decreasing symptoms (Askovic et al., 2023).

Q: Is neurofeedback recommended as a treatment for PTSD according to the VA/DOD clinical practice guidelines (CPGs)?

A: No. The *2023 VA/DOD Clinical Practice Guideline for the Management of Posttraumatic Stress Disorder and Acute Stress Disorder* states that there is insufficient evidence to recommend for or against neurofeedback for the treatment of PTSD.

The VA/DOD CPGs were jointly developed by the Department of Veterans Affairs and the Department of Defense to inform best clinical practices. They are developed under the purview of clinical experts and are derived through a transparent and systematic approach that includes, but is not limited to, systematic reviews of the literature on a given topic and development of recommendations using a graded system that takes into account the overall quality of the evidence and the magnitude of the net benefit of the

recommendation. A further description of this process and CPGs on specific topics can be found on the VA clinical practice guidelines website.

Q: Do other authoritative reviews recommend neurofeedback as a treatment for PTSD?

A: No. The American Psychological Association and the National Institute for Health and Care Excellence (NICE) in the United Kingdom both state there is insufficient evidence to recommend for or against neurofeedback for treatment of PTSD. No relevant Cochrane reviews were found on neurofeedback for treatment of PTSD.

Other recognized organizations publish CPGs or conduct systematic reviews and evidence syntheses on psychological health topics using similar grading systems as the VA/DoD CPGs. These include the American Psychological Association, and United Kingdom's National Institute for Health and Care Excellence. Additionally, Cochrane is an international network that conducts high-quality reviews of healthcare interventions.

Q: What conclusions can be drawn about the use of neurofeedback as a treatment for PTSD?

A: Based on the clinical guidelines, neurofeedback has insufficient evidence to recommend for or against it as a treatment for PTSD, indicating that more research is needed to establish its efficacy for this population. For patients who have not responded to or do not prefer recommended PTSD treatment, clinicians may consider this treatment among PTSD treatment options. As always, clinical judgment and expertise, patient characteristics and treatment history, and patient preferences should be considered when selecting a treatment.

References

Askovic, M., Soh, N., Elhindi, J., & Harris, A. W. F. (2023). Neurofeedback for post-traumatic stress disorder: Systematic review and meta-analysis of clinical and neurophysiological outcomes. *European Journal of Psychotraumatology*, *14*(2), 1-18. https://doi.org/ https://doi.org/10.1080/20008066.2023.2257435

Department of Veterans Affairs/Department of Defense. (2023). VA/DOD clinical practice guideline for the management of posttraumatic stress disorder and acute stress disorder. (Version 4.0). https://www.healthquality.va.gov/guidelines/mh/ptsd/

Nicholson, A. A., Densmore, M., Frewen, P. A., Neufeld, R. W., Théberge, J., Jetly, R., Lanius, R.A., & Ros, T. (2023). Homeostatic normalization of alpha brain rhythms within the default-mode network and reduced symptoms in post-traumatic stress disorder following a randomized controlled trial of electroencephalogram neurofeedback. *Brain Communications*, *5*(2), fcad068. https://doi.org/10.1093/braincomms/fcad068

Nicholson, A., Ros, T., Jetly, R., & Lanius, R. A. (2020). Regulating posttraumatic stress disorder symptoms with neurofeedback: Regaining control of the mind. *Journal of Military, Veteran, and Family Health, 6*(Supp 1), 3-15. https://doi.org/10.3138/jmvfh.2019-0032

Orndorff-Plucket, F., Singh, F., Aragon, O. R., & Pineda, J. A. (2017). Assessing the effectiveness of neurofeedback training in the context of clinical and social neuroscience. *Brain Sciences, 7*(8), 95-117. https://doi.org/10.3390/brainsci7080095

Papo, D. (2019). Neurofeedback: Principles, appraisal, and outstanding issues. *European Journal of Neuroscience*, *49*(11), 1454-1469. https://doi.org/10.1111/ejn.14312

Sitaram, R., Ros, T., Stoeckel, L., Haller, S., Scharnowski, F., Lewis-Peacock, J., Weiskopf, N., Blefari, M. L., Rana, M., Oblak, E., Birbaumer, N., & Sulzer, J. (2017). Closed-loop brain training: The science of neurofeedback. *Nature Reviews Neuroscience, 18*(2), 86-100. https://doi.org/10.1038/nrn.2016.164

Thibault, R. T., MacPherson, A., Lifshitz, M., Roth, R. R., & Raz, A. (2018). Neurofeedback with fMRI: A critical systematic review. *NeuroImage, 172*, 786-807. https://doi.org/10.1016/j.neuroimage.2017.12.071

Zhao, Z., Duek, O., Seidemann, R., Gordon, C., Walsh, C., Romaker, E., Koller, W.N, Horvath, M., Awasthi, J., Wang, Y., O'Brien, E., Fichtenholtz, H., Hampson, M., & Harpaz-Rotem, I. (2023). Amygdala downregulation training using fMRI neurofeedback in post-traumatic stress disorder: A randomized, double-blind trial. *Translational Psychiatry*, *13*(1), 177-188. https://doi.org/10.1038/s41398-023-02467-6