Neurofeedback to Alter Brain Waves Associated With Negative Tinnitus Distress

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Neurofeedback is a therapeutic tool used by mental health professionals to treat a variety of conditions, including attention deficit disorder, traumatic brain injury, post-traumatic stress disorder, autism, and even insomnia. In neurofeedback, brain waves measured by electroencephalography (EEG) create auditory or visual signals that are presented to the patient as either sound (often music) or visual displays sometimes similar to a video game.

The goal is for patients to use the feedback to change their brain activity to achieve desired outcomes. What outcomes are desired depends on the condition being treated. For example, when treating PTSD, the patient may need to become more relaxed or focused to change the feedback on the screen to the desired state. As the patient works toward the treatment objectives, positive reinforcement is provided. The idea is that individuals can change their brain patterns, with the eventual goal of creating long-lasting changes in behavior.

There is a fair degree of criticism of neurofeedback, with most critics pointing out the lack of solid and consistent evidence supporting its use.

A group of researchers in Switzerland and Germany looked at the possibility of using neurofeedback for treatment of tinnitus.[1] They specifically targeted improvement in tinnitus loudness and tinnitus distress using a protocol that was tailored to individual subjects. The researchers used the Tinnitus Handicap Inventory (THI) and Tinnitus Questionnaire (TQ) to track tinnitus severity. Subjects indicated tinnitus loudness using a scale of 0 to 100.

Potential participants were screened to ensure they had experienced tinnitus for at least six months and had no psychiatric disorders or other potentially confounding conditions. A total of 24 individuals were recruited and ultimately completed 15 weeks of treatment with EEG measurement. Follow-ups were conducted with questionnaires at three and six months after treatment.

Brain waves measured through EEG recording were classified according to their frequency. To envision this, think of waves washing up on a beach. Waves occurring at a lower frequency result in a broader, seemingly slower movement. Higher frequency waves hit the beach more rapidly, and the waves occur closer together. Frequency is measured in Hertz (Hz), which is how many times the waves hit the beach each second. Brain waves are categorized by frequency range, although some researchers and clinicians have slightly different frequency ranges for their working definitions. Delta waves are generally considered to be measured in the 0.5 Hz to 4 Hz frequency range., Theta waves occur in the range of 3 or 4 Hz up to 8 Hz. Alpha waves are considered to be somewhere in the 8–14 Hz range. Beta waves are higher frequency than alpha waves, up to approximately 38 Hz and gamma waves are measured around 38–42 Hz. Higher frequency brain waves are correlated with alert, conscious activity, and lower frequency brain waves are associated with deep sleep or can indicate negative brain patterns. Higher frequency brain waves that occur at inappropriate times may indicate nightmares, hypervigilance, or impulsivity, and lower frequency brain waves at inappropriate times may be associated with depression or inattentiveness/daydreaming and may contribute to insomnia.

In prior neurofeedback research, tinnitus symptoms were reported to improve when a protocol that targeted increasing alpha-range activity and inhibiting delta-range activity was used. In those studies, specific fixed frequencies within the alpha band (8–12 Hz) and delta band (3–4 Hz) were measured and used to provide feedback/rewards.

The authors of the current study recognized that alpha-range brain activity may vary significantly from one person to another and sought to customize the alpha measurement. They accomplished this by measuring only the specific alpha frequency containing the greatest amount of—or peak—power.

After 15 sessions of neurofeedback with this customized protocol, the authors found that scores on both the THI and TQ improved, indicating lower tinnitus distress. After six months of treatment, scores on each questionnaire remained stable. Tinnitus loudness ratings one week after treatment were significantly lower than before treatment but increased to pretreatment levels by three and six months after the treatment stopped.

This suggests that neurofeedback may provide a short-term effect on tinnitus loudness. However, this protocol does not result in persistent reduction in loudness after treatment concludes. The authors reported that tinnitus loudness was decreased more permanently in previous studies that used more aggressive and longer treatment schedules (2–3 times per week for 20 to 30 minutes rather than once weekly for 15 minutes in this study). Subjects' rating of tinnitus distress, measured with questionnaires, improved after treatment and remained at post-treatment levels for six months, although improvements have not been related to other therapies or to placebo, which have a large effect in tinnitus treatment. A study with a larger sample size is needed to look at effects of neuromodulation across a broader range of subjects and to allow analysis of additional factors.

1 Gütensperger, D., Thüring, C., Kleinjung, T., Neff, P., & Meyer, M. (2019). Investigating the efficacy of an individualized alpha/delta neurofeedback protocol in the treatment of chronic tinnitus. *Neural Plasticity, 19*, article 3540898.

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