Introduction to Neurofeedback for Trauma: Mechanisms, Relevance, and Clinical Overview

A foundational overview for survivors and clinical practice.

Course Objectives

Introduction to neurofeedback practice, science, and history

Research and outcomes on PTSD

Emerging clinical applications and the future use for PTSD

Important Frontloading:

- “Neurofeedback” is not a regulated term. This lecture focuses on classic neurofeedback—specifically EEG biofeedback. Neurofeedback is often conflated with various “stim” devices, but these are distinct approaches, and such confusion can be misleading and triggering for some individuals.
- The medical terms for brain waves are Greek letters, which carry symbolic meaning and may be triggering for some. These labels were chosen by early researchers based on the order of the Greek alphabet and the sequence in which the frequency bands were discovered.
- If you feel overwhelmed, you are always free to pause, leave, or disengage without explanation; there is no expectation that you stay to the end.

History of Neurofeedback

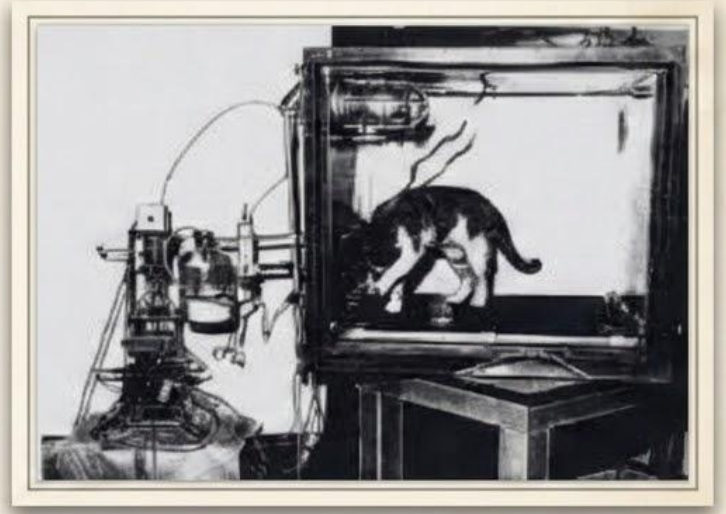
1958-1964: Discovery
NASA & UCLA lab under Dr. Barry Sternman.

Accidental Finding
Cats became significantly more resilient to toxic exposure.

1969: Validation
Repeated experiment to validate findings (Sterman, et. al.)

Decades of Research
Hundreds of studies for epilepsy and trauma.

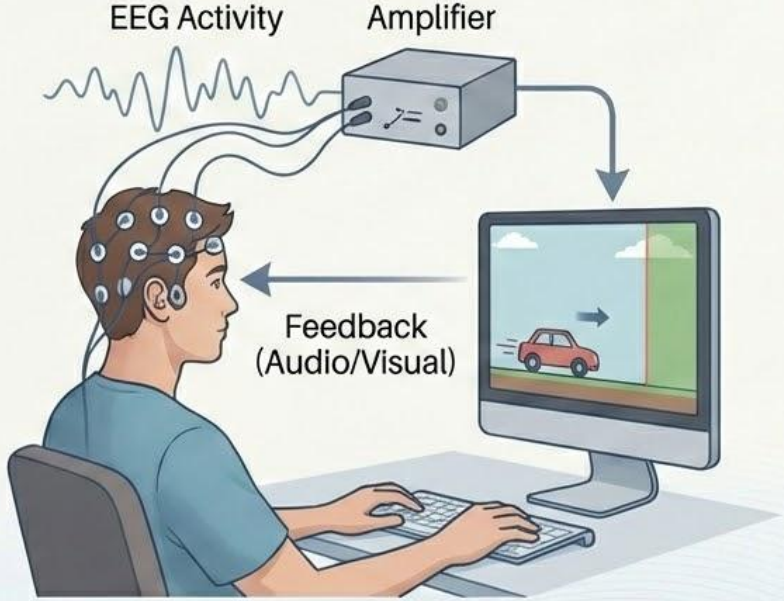
Efficacy Today
4 out of 5 Efficacious for Epilepsy & PTSD (Khazan, et. al., 2023)



Dr. Barry Sterman's Laboratory, c. 1960s.
The pioneering neurofeedback experiment.

What is Neurofeedback (EEG Biofeedback)?

- Non-invasive brain training method
- Based on operant conditioning principles
- Real-time monitoring of brainwave activity (EEG)
- Provides immediate audio/visual feedback to reward desired patterns



Self-Regulation Loop

The Session: A Glimpse into the Process

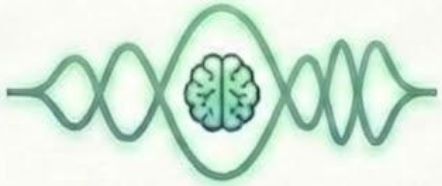
- **Preparation**: Sensors placed on the scalp (specific sites determined by assessment)
- **Training**: Client engages with feedback (watching a movie/game) driven by their brainwaves
- **Role of Therapist**: Monitors EEG, adjusts thresholds, provides coaching and support
- **Duration:** Typically 30-45 minute sessions, multiple sessions required

Common Neurofeedback Protocols for PTSD

Infra-Low Frequency (ILF) Training

- Focuses on very slow brain rhythms
- Stabilizes the nervous system (calming arousal)

Alpha-Theta and Alpha-Down Training



- Facilitates a deep meditative state
- Processes trauma and emotional integration

SMR (Sensorimotor Rhythm) Training

- Enhances physical calm and cognitive focus
- Reduces hypervigilance
- Stabilization

Outcomes & Path Forward

Benefits (Symptom Reduction & Regulation)

- Reduced symptom severity (flashbacks, anxiety, nightmares)
- Improved sleep quality and emotional regulation
- Enhanced adjunctive therapy outcomes (e.g., talk therapy, EMDR, etc...)

Considerations (Clinical & Practical)

- Not a standalone "cure" (often adjunctive to psychotherapy)
- Requires significant time commitment (multiple sessions over weeks/months)
- Importance of comprehensive assessment & specialized training

Integrative Treatment Approach

Neurobiology of PTSD & Neurofeedback's Role

PTSD Brain Dysregulation

- Autonomic nervous system (ANS) dysregulation (hyperarousal/hypoarousal)
- Altered connectivity in key brain areas (e.g., amygdala, prefrontal cortex)
- Chronic stress state, difficulty shifting states

Neurofeedback Goal: Enhanced Regulation

- Targets underlying neural dysregulation directly
- Trains self-regulation and neural flexibility
- Reduces symptom severity (flashbacks, anxiety)

Bibliography: Landmark Studies (Foundational Randomized Controlled Studies)

Gapen et al. (2016)

Gapen, M., van der Kolk, B. A., Hamlin, E., Hirshberg, L., Suvak, M., & Spinazzola, J. (2016). A pilot study of neurofeedback for chronic PTSD. *Applied Psychophysiology and Biofeedback, 41*(3), 251–261. https://doi.org/10.1007/s10484-015-9326-5

💡 *(Proof-of-concept pilot in multiply-traumatized adults.)*

Peniston & Kulkosky (1991)

Peniston, E. G., & Kulkosky, P. J. (1991). Alpha-theta brainwave neuro-feedback therapy for Vietnam veterans with combat-related post-traumatic stress disorder. *Medical Psychotherapy, 4*, 47–60.

🧠 *(Classic alpha-theta protocol origin; verified as foundational for PTSD symptom reduction via theta/alpha crossover training.)*

van der Kolk et al. (2016)

van der Kolk, B. A., Hodgdon, H., Gapen, M., Musicaro, R., Suvak, M. K., Spinazzola, J., & Hamlin, E. (2016). A randomized controlled study of neurofeedback for chronic PTSD. *PLoS ONE, 11*(12), Article e0166752. https://doi.org/10.1371/journal.pone.0166752

⚙️ *(Waitlist-controlled RCT, n=52; EEG neurofeedback significantly reduced PTSD symptoms.)*

A pilot study of neurofeedback for chronic PTSD by the AAPB

Summary:

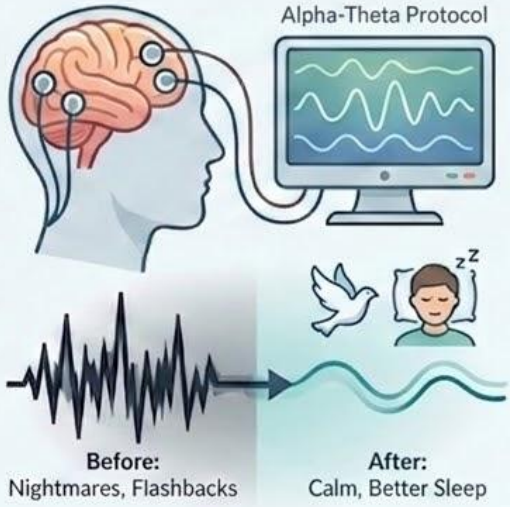
- Small “proof-of-concept” study with adults suffering from chronic PTSD and multiple traumas.
- Participants had strong symptoms that were treatment-resistant.
- Received neurofeedback sessions to help the brain learn to stay calm.
- **Results**: Clear improvements in PTSD symptoms and emotion management.
- **Conclusion:** Promising early sign for long-lasting trauma; bigger studies recommended to confirm.

(Gapen, et. al., 2016)

Alpha-theta brainwave neurofeedback therapy for Vietnam veterans with combat-related post-traumatic stress disorder: Early Study (the one that started it all)

Summary:

In this early study, Vietnam veterans with severe combat PTSD learned to relax deeply using a special type of brain-training called alpha-theta neurofeedback. They sat quietly while sensors on their head gave them gentle feedback (like sounds or lights) whenever their brain waves slowed into a calm state. After the training, the veterans reported big drops in nightmares, flashbacks, and anxiety. Many felt calmer and slept better. This was one of the first times researchers showed that teaching the brain to produce these relaxed “alpha-theta” waves could help heal trauma symptoms.



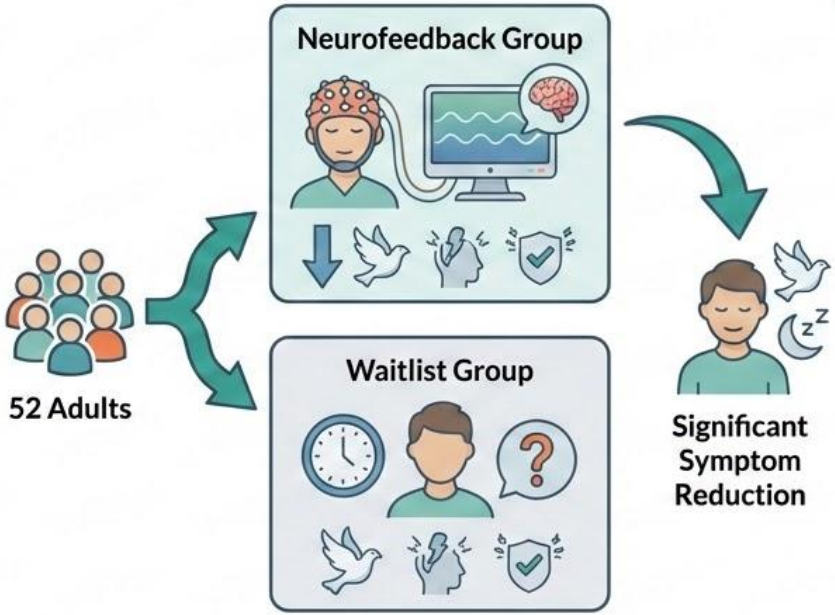
(Peniston & Kulkosky, 1991)

A randomized controlled study of neurofeedback for chronic PTSD: Landmark Study

Study Summary:

- 52 adults with long-term PTSD randomly split into two groups.
- **Neurofeedback Group:** Received 24 sessions of EEG neurofeedback (safe, non-drug brain-training).
- **Waitlist Group:** Continued usual care.
- **Results:** Neurofeedback group showed much bigger improvements in PTSD symptoms:
  - Fewer flashbacks
  - Less anxiety
  - Better emotional control
- **Benefits** comparable to leading trauma therapies.
- **Cited** for using a real comparison group.

(van der Kolk, et. al., 2016)



Let’s look at some meta-analysis studies

Neurofeedback for Post-Traumatic Stress Disorder

Systematic Review and Meta-analysis of Clinical and Neurophysiological Outcomes

Symptom Reduction: Flashbacks, anxiety, feeling "on edge" are reduced.

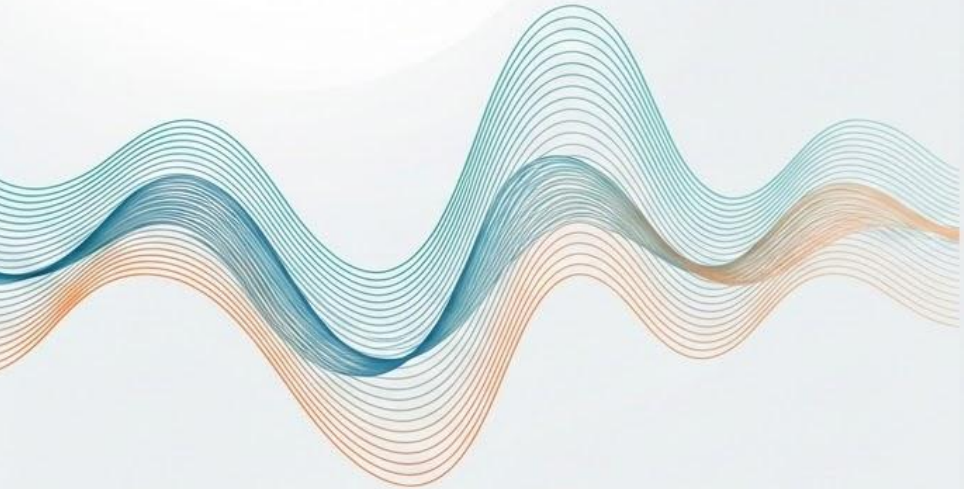
Moderate Effect Size: Clearly helpful improvements, not a "miracle cure".

Healthier Brain Patterns: Observed neurophysiological changes post-training.

Conclusion: Promising, safe option alongside other trauma treatments.

(Askovic, et., al., 2023)

A systematic review and meta-analysis of neurofeedback for PTSD



Summary:

- **Scientists examined every recent neurofeedback study for PTSD** (Berman, et al., 2025).
- **Confirmed most helpful approaches**: Alpha/theta training and alpha-down protocols.
- **Gently teaches brain to calm down** and stay balanced.
- **Shows real improvements** in PTSD symptoms.
- **Meaningful brain changes** measured on EEG.
- One of the core EEG-based tools for lasting relief.
- Safe, non-drug, and works well as an add-on to regular therapy.

Emerging clinical Application and Future Use

Emerging clinical Application and Future Use

Federal CPT Board Lobbying

- Currently lobbying federal government.
- New CPT codes anticipated for 2027.
- New hope for insurance reimbursement via “valuation” process.

Efficacy Rating Potential

- Reasonable hope for upgrade from 4 (efficacious) to 5 (efficacious and specific).
- Driven by better recent research.

Field Growth & Challenges

- Improved access to neurofeedback.
- Increased quality control concerns with rapid growth.

Questions & Answers

Open discussion on neurofeedback for trauma.

- Mechanisms & Science
- Clinical Applications
- Patient Experiences & Outcomes
- Future Directions

Bibliography

Khazan, I., Shaffer, F., Moss, D., Lyle, R. R., & Rosenthal, S. (Eds.). (2023). Evidence-based practice in biofeedback and neurofeedback (4th ed.). Association for Applied Psychophysiology and Biofeedback.

Sterman, M. B., LoPresti, R. W., & Fairchild, M. D. (1969, June). Electroencephalographic and behavioral studies of monomethylhydrazine toxicity in the cat (AMRL-TR-69-3). Aerospace Medical Research Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. https://apps.dtic.mil/sti/tr/pdf/AD0691474.pdf

Recent RCTs & Mechanistic Studies (2017–2025; qEEG-Focused, Alpha Protocols)

Nicholson, A. A., Ros, T., Densmore, M., Frewen, P. A., Neufeld, R. W. J., Théberge, J., Jetly, R., & Lanius, R. A. (2020). A randomized, controlled trial of alpha-rhythm EEG neurofeedback in posttraumatic stress disorder: A preliminary investigation showing evidence of decreased PTSD symptoms and restored default mode and salience network connectivity using fMRI. NeuroImage: Clinical, 28, Article 102490. https://doi.org/10.1016/j.nicl.2020.102490

Nicholson, A. A., Densmore, M., Frewen, P. A., Neufeld, R. W. J., 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), Article fcad068. https://doi.org/10.1093/braincomms/fcad068

Shaw, S. B., Nicholson, A. A., McKinnon, M. C., Jetly, R., Lanius, R. A., & Ros, T. (2023). Increased top-down control of emotions during symptom provocation working memory tasks following a RCT of alpha-down neurofeedback in PTSD. NeuroImage: Clinical, 37, Article 103313. https://doi.org/10.1016/j.nicl.2023.103313

Bell, A., Moss, D., & Kallmeyer, R. J. (2019). Healing the neurophysiological roots of trauma: A controlled study examining LORETA z-score neurofeedback and HRV biofeedback for chronic PTSD. NeuroRegulation, 6(2), 54–72. https://doi.org/10.15540/nr.6.2.54

Leem, J., Cheong, M. J., Lee, H., Lee, S. Y., Kim, G.-W., & Kang, H. W. (2021). Effectiveness, cost-utility, and safety of neurofeedback self-regulating training in patients with post-traumatic stress disorder: A randomized controlled trial. Healthcare, 9(10), Article 1351. https://doi.org/10.3390/healthcare9101351

Meta-Analyses & Systematic Reviews (Evidence Synthesis, 2020–2025)

Additional High-Relevance Studies (Children, Developmental Trauma, Adjunctive)

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), Article 2257435. https://doi.org/10.1080/20008066.2023.2257435 (Moderate effect sizes; highlights alpha/theta and alpha-down protocols.)

Berman, D. E., et al. (2025). Systematic review and meta-analysis of neurofeedback for PTSD. (PMC-indexed; confirms alpha/theta and alpha-down as core EEG-NF approaches with clinical gains.)

Additional High-Relevance Studies (Children, Developmental Trauma, Adjunctive)

Rogel, A., et al. (2020). The impact of neurofeedback training on children with developmental trauma: A randomized controlled study. Applied Psychology: Health and Well-Being, 12(1), 134–154. https://doi.org/10.1111/aphw.12184

Shaffer, F., Zerr, A. A., & Crawford, C. (2023). Evidence-based practice in biofeedback and neurofeedback (4th ed.). Association for Applied Psychophysiology and Biofeedback. (PTSD chapter with qEEG phenotype ties.)