

# BIOFEEDBACK

## WHAT IS IT?

Biofeedback uses various devices to measure physiological activities, with the intent of improving health and/or performance by learning to consciously control those activities. Clinical biofeedback emerged as a discipline starting in the late 1950s, as increasing numbers of technologies were developed to measure different physical functions. Since that time, it has expanded dramatically.

Any number of body functions can be monitored in biofeedback. Certain biofeedback devices work best for different conditions. For example, measuring muscle tension can help with tension headaches, while neurofeedback works well for attention deficit and hyperactivity disorder (ADHD). Important examples of biofeedback devices include the following:

- Hand temperature (thermal biofeedback therapy)
- Skin conductance (electrodermal response)
- Respiratory rate and chest wall expansion
- Cardiovascular measurements, including heart rate (pulse) and heart rate variability (HRV), which are the beat-to-beat differences noted on a heart monitor
- Electroencephalography (EEG). EEG biofeedback is most typically referred to as neurofeedback.
- Muscle tension (electromyography or EMG)
- Number of steps, measured on a pedometer or other wearable device
- Body weight (even your scale is a biofeedback device of sorts)

## HOW IT WORKS

Seeing how these measurements change in real time in response to different emotions, thoughts, or behaviors empowers a person to mentally control physical functions they may not have previously been aware they could control. The end goal is to learn how to change body functions to improve health and/or performance, in a way where ideally the changes will endure without continued use of an instrument.

In a clinical setting, a practitioner might combine biofeedback with other treatments, such as Cognitive Behavioral Therapy (CBT), relaxation techniques or specific physical movements, such as in physical therapy. Biofeedback can provide one element of a multifaceted intervention, enhancing the efficacy of other treatments by drawing a person's

awareness to their own ability to consciously change their body functions. Through biofeedback, individuals can become more aware of their own role in influencing health and disease; it can be quite empowering to patients.

## WHEN TO USE IT

Most people appreciate or enjoy the use of biofeedback to obtain physiological information. Consider biofeedback for people who tend to be more technology-minded, reluctant to accept a referral for individual talk psychotherapy or like to see concrete data related to how their mental efforts affect them physically.

One form of biofeedback, HRV, has been the focus of multiple recent systematic reviews and meta-analyses. Benefits have been shown to be reductions in stress, anxiety, PTSD, depression and panic symptoms, anger, improved athletic/artistic performance, sleep and quality of life.[1-4] Several of these reviews studied depression specifically and found both biofeedback and neurofeedback associated with reduced depressive symptomology.[5,6] Significant positive effects were found in various patient profiles using HRV including hypertension, cardiovascular prognosis, inflammatory state, asthma disorders, improved cancer symptoms and well-being, improving pulmonary function during asthma attacks, reduced risk of admissions, emergency room visits, and depression in people with coronary artery disease.[7-10] Even HRV interventions that were phone-based showed improved cardiovascular function.[11]

A systematic review looked at whether HRV could enhance executive functioning (EF) across the lifespan and found that it increased attentional skills, inhibition and working memory.[12] Neurofeedback studies showed that healthy subjects could significantly improve working and episodic memory.[13-15] Several studies suggest that HRV shows promise as a complement to first line substance use treatment especially with mitigating cravings.[16-18]

A recent systematic review found support for EMG biofeedback for improving balance in elderly populations.[19] For those who are visually impaired due to macular disease, biofeedback was able to improve oculomotor abilities including fixation stability and reading speed.[20] Several systematic reviews found benefit to improving swallowing function.[21,22] In patients with Parkinson's Disease and dysphagia, biofeedback had a positive effect on swallowing-related quality of life. Post-stroke functioning using EMG biofeedback has been the focus of several studies. Benefits are noted for stroke rehabilitation and improved gait.[23,24] For use in post-stroke upper limb function studies showed that biofeedback associated with conventional therapy had a small clinical effect.[25]

Recent studies have been especially favorable regarding the potential for biofeedback to treat various types of chronic pain. In Sielski et al. meta-analysis of chronic back pain, the authors found significant small to medium effect size for pain intensity reduction that proved to be stable at 8-month follow-up, as well as decreased disability, muscle tension, depression and improved cognitive coping.[4] Studies of neck pain found EMG biofeedback

to have equal or better effectiveness than control interventions, a moderate effect on short term disability and a small effect on intermediate-term disability.[26,27] Pelvic pain treated with biofeedback-assisted training had a positive effect on pain reduction, overall symptoms relief and quality of life.[28] Biofeedback helps with various types of headaches and has been given a “Grade A” evidence rating by various national organizations.[29] In systematic reviews and meta-analyses, neurofeedback was found to show a moderate improvement in chronic pain, as well as secondary symptoms of depression, anxiety, fatigue, and sleep issues in many of the studies.[30,31]

Several systematic reviews and a meta-analysis in 2021 found that pelvic floor muscle training (PFMT) combined with EMG biofeedback achieved better outcomes than PFMT alone for stress urinary incontinence, pelvic floor dysfunction, including increased pelvic floor muscle strength.[32] This is different from an earlier 2019 review which did not see an additional benefit to EMG biofeedback.[33] The combination of PFMT and EMG biofeedback was also shown to be superior for chronic constipation with dyssynergic defecation, fecal incontinence and low anterior resection syndrome.[34] One study indicates that home biofeedback helps with dyssynergic defecation.[35]

Obsessive-Compulsive Disorder was shown to benefit from neurobiofeedback, even when compared to other treatments.[36] Further studies were needed in order to draw conclusions about the effectiveness of biofeedback in treating irritable bowel syndrome.[38] Electrodermal feedback shows promise with reducing pain and chronic inflammation.[39]

## **BIOFEEDBACK RESEARCH: A SUMMARY**

A rating system for efficacy for biofeedback is used by national and international groups. The disorders most commonly assessed using psychophysiological recording techniques and treated using biofeedback-based interventions which have been shown to be reasonably efficacious through research studies are included in the section below. The ratings are featured on the website of the [Association for Applied Psychophysiology and Biofeedback](#). [40]

- ADD & ADHD
- Alcoholism
- Anxiety
- Arthritis
- Asthma
- Breathing Problems
- Chest pain
- Chronic pain
- Constipation
- Drug Addiction
- Epilepsy/Seizure
- Fecal Elimination Disorder
- Headaches
- Hypertension
- Hyperventilation
- Incontinence
- Insomnia
- Irritable Bowel Syndrome
- Jaw Area Pain
- Knee Pain
- Low Back Pain
- Non-Cardiac Chest Pain
- Pain
- Phantom Limb Pain
- Posture related pain
- Raynaud's Syndrome
- Stump Pain
- Subluxation of the Patella
- Substance Abuse
- Temporomandibular Disorder
- Traumatic Brain Injury
- TMJ/TMD
- Urinary Elimination Disorders
- Vulvar Vestibulitis

Efficacy is rated on a scale of 1 - 5 with 5 being the best. All disorders listed above have been rated as having at least level 3 evidence supporting their efficacy.

*The ratings of efficacy presented are compiled from The Association for Applied Psychophysiology and Biofeedback's list of disorders and treatments as well as Yucha and Gilbert's 2004 book on biofeedback and neurofeedback.[40-42]*

## WHAT TO WATCH OUT FOR (HARMS)

Biofeedback is very safe, provided that instrumentation is operated correctly, and practitioners are able to set reasonable and safe parameters and goals for a person to aim for when using various measures. There are various products a person can use on their own to do biofeedback as well, but it is best to have support from a trained professional, especially early on.

## TIPS FROM YOUR WHOLE HEALTH COLLEAGUES

Most experts would agree that it is best to obtain biofeedback from a qualified health care professional. A variety of qualified professionals can offer biofeedback, ranging from psychologists and physicians to nurses, occupational therapists, physical therapists, and social workers.

Get to know practitioners at your site and in your local community. To find certified biofeedback professionals who practice in a certain part of the country, use the following as resources:

- Association for Applied Psychophysiology and Biofeedback. <https://aapb.org/>.
- Biofeedback Certification International Alliance. <https://www.bcia.org/>. The BCIA was established to provide certification for biofeedback providers worldwide.
- International Society for Neuroregulation & Research (ISNR). <https://isnr.org/>. Organization built around neurofeedback.

## RESOURCES

### VA WHOLE HEALTH WEBSITE AND RELATED SITES

- Whole Health Veteran Handouts - Biofeedback.  
<https://www.va.gov/WHOLEHEALTH/Veteran-Handouts/docs/Biofeedback-Final508-07-12-2018.pdf>
- Evidence Map of Biofeedback:  
<https://www.hsrdr.research.va.gov/publications/esp/guided-imagery.cfm>
- Integrative Health Coordinating Center SharePoint on Biofeedback.  
<https://dvagov.sharepoint.com/sites/VHAOPCC/IHCC/SitePages/Biofeedback.aspx>
- CIH Listservs. To be added, contact:
  - Biofeedback listerv: [VHAOPCC&CTBiofeedback@va.gov](mailto:VHAOPCC&CTBiofeedback@va.gov)

- Other listservs: [Lana.Frankenfield@va.gov](mailto:Lana.Frankenfield@va.gov)

## OTHER WEBSITES

- [Association for Applied Psychophysiology and Biofeedback](https://aapb.org/). <https://aapb.org/>
- [Biofeedback Certification International Alliance](https://www.bcia.org/). <https://www.bcia.org/>
- [Heart Math for Troops, Veterans and Families](https://www.facebook.com/heartmathtroopsveteransfamilies/). <https://www.facebook.com/heartmathtroopsveteransfamilies/>
- [International Society for Neuroregulation & Research \(ISNR\)](https://isnr.org/). <https://isnr.org/>

## BOOKS

- Evidence-Based Practice in Biofeedback and Neurofeedback (3<sup>rd</sup> ed), Gabriel Tan, Frederic Shaffer, Randall Lyle, Irene Teo, Randy R. Lyle (2016).
- Biofeedback: A Practitioner's Guide (4th ed), Mark S Schwartz & Frank Andrasik (2017).
- The Clinical Handbook of biofeedback: A step-by Step Guide for Training and Practice with Mindfulness, Inna Z. Khazan (2013).

## APPS AND MONITORING SOFTWARE

- **BioZen**. Created by U.S. Department of Defense for Android. Requires sensor.
- **Elite HRV Free application but requires purchase of HRV sensor.**
- **Heart Math ([heartmath.com](https://heartmath.com)) Application and sensor.**

## AUTHOR(S)

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## REFERENCES

1. Blase K, Vermetten E, Lehrer P, Gervitz R. Neuropsychological approach by self-control of your stress-related autonomic nervous system with depression, stress and anxiety patients. *Int J Environ Res Public Health*. 2021;18(7):3329.

2. Goessl VC, Curtiss JE, Hofmann SG. The effect of heart rate variability biofeedback training on stress and anxiety: a meta-analysis. *Psycho Med*. 2017;47(15):2578-2586.
3. Lehrer P, Kaur K, Sharma A, Shah K, Huseby R, Bhavsar J, Sgobba P, Zhang Y. Heart rate variability biofeedback improves emotional and physical health and performance: a systematic review and meta-analysis. *Applied Psychophysiology and Biofeedback*. 2020;45:109-129.
4. Sielski R, Rief W, Glombiewski JA. Efficacy of biofeedback in chronic back pain: a meta-analysis. *Int J Behav Med*. 2017;24(1):25-41.
5. Fernandez-Alvarez J, Grassi M, Colombo D, Botella C, Cipresso P, Perna G, Riva G. Efficacy of bio- and neurofeedback for depression: a meta-analysis. Published online by Cambridge University Press: November 15, 2021. Accessed February 2, 2023.
6. Pizzoli SFM, Marzorati C, Gatti D, Monzani D, Mazzocco K, Pravettoni G. A meta-analysis on heart rate variability biofeedback and depressive symptoms. *Sci Rep*. 2021;11(6650).
7. Taghizadeh N, Eslaminejad A, Raoufy MR. Protective effect of heart rate variability biofeedback on stress-induced lung function impairment in asthma. *Respir Physiol Neurobiol* 2019;262:49-56.
8. Fournie C, Chouchou F, Dalleau G, Caderby T, Cabrera Q, Verkindt C. Heart rate variability biofeedback in chronic disease management: a systematic review. *Complementary Therapies in Medicine*. 2021;60(102750).
9. Spada GE, Masiero M, Pillolle SFM, Pravettoni G. Heart rate variability biofeedback in cancer patients: a scoping review. *Behav Sci*. 2022;12(10):389.
10. Yu LC, Lin IM, Fan SY, Chien CL, Lin TH. One-year cardiovascular prognosis of the randomized, controlled, short-term heart rate variability biofeedback among patients with coronary artery disease. *Int J Behav Med*. 2018;25(3):271-282.
11. Schumann A, Kohler S, Brotte L, Bar KJ. Effect of an eight-week smartphone-guided HRV-biofeedback intervention on autonomic function and impulsivity in healthy controls. *Physiol Meas*. 2019;40(6):064001.
12. Tinello D, Kliegel M, Zuber S. Does heart rate variability biofeedback enhance executive functions across the lifespan? A systematic review. *Journal of Cognitive Enhancement*. 2022;6:126-142.
13. Yeh, WH, Hsueh JJ, Shaw FZ. Neurofeedback of alpha activity on memory in healthy participants: a systematic review and meta-analysis. *Front Hum Neurosci*. 2021;(14). <https://doi.org/10.3389/fnhum.2020.562360>.
14. Viviani G, Valeis A. EEG-neurofeedback and executive function enhancement in healthy adults: a systematic review. *Psychophysiology*. 58(9),e13874.
15. Yeh WH, Ju YJ, Liu YT, Wang TY. Systematic review and meta-analysis on the effects of neurofeedback training of theta activity on working memory and episodic memory in healthy population. *Int J Environ Res Public Health*. 2022 Sep 03;19(17).
16. Alayan N, Eddie D, Eller L, Bates ME, Carmody DP. Substance craving changes in university students receiving heart rate variability biofeedback: A longitudinal multilevel modeling approach. *Addictive behaviors*. 2019;97,35-41.
17. Weiman ST, Eddie D. Heart rate variability biofeedback for substance use disorder: health policy implications. *Insights from Behavioral and Brain Sciences*. 2022;9(2):156-163.

18. Alayan N, Eller L, Bates ME, Carmody DP. Current evidence on heart rate variability biofeedback as a complementary anticraving intervention. *J Altern Complement Med*. 2018;24(11):10391050.
19. Alhasan H, Hood V, Mainwaring F. The effect of visual biofeedback on balance in the elderly population: a systematic review. *Clin Interv Aging*. 2017;12:487-497.
20. Silvestri V, Turco S, Piscopo P, Guidobaldi M, Perna F, Sulfaro M, Armore F. Biofeedback stimulation in the visually impaired: a systematic review of literature. *Ophthalmic and Physiological Optics*. 2021;41(2):342-364.
21. Albuquerque LCA, Pernambuco L, da Silva CM, Chateaubriand MM, Da Silva HJ. Effects of electromyographic biofeedback as an adjunctive therapy in the treatment of swallowing disorders: a systematic review of the literature. *Eur Arch Otorhinolaryngol*. 2019;276(4):927-938.
22. Battel I, Calvo I, Walshe M. Interventions involving biofeedback to improve swallowing in people with Parkinson Disease and Dysphagia: a systematic review. *Archives of Physical Medicine and Rehabilitation*. 2021;102(2):314-322.
23. Tsaih PL, Chiu MJ, Luh JJ, Yang YR, Lin JJ, Hu MH. Practice variability combined with task-oriented electromyographic biofeedback enhances strength and balance in people with chronic stroke. *Behav Neurol*. 2018;7080218.
24. Spencer J, Wolf SL, Kesar TM. Biofeedback for post-stroke gait retraining: a review of current evidence and future research directions in the context of emerging technologies. *Front Neurol*. 2021;12:637199.
25. Bonini-Rocha AC, Andrade ALS, Pereira RDS, Moraes AM, Matheus LBG, Fonsecal ST, Ribeiro ALDA, Martins WR. *J Hand Therapy*. 2022 July 8;17(9).
26. Tsiringakis G, Dimitriadis Z, Triantafylloy E, McLean S. Motor control training of deep neck flexors with pressure biofeedback improves pain and disability in patients with neck pain: a systematic review and meta-analysis. *Musculoskelet Sci Pract*. 2020 Dec;50:102220.
27. Campo M, Zaire JR, Pappas E, Monticone M, Secci C, Scalzitti D, Findley JL, Graham PL. The effectiveness of biofeedback for improving pain, disability and work ability in adults with neck pain: a systematic review and meta-analysis. *Musculoskelet Sci Pract*. 2021 Apr;52:102317.
28. Wagner B, Steiner M, Huber DFX, Crevenna R. The effect of biofeedback interventions on pain, overall symptoms, quality of life and physiological parameters in patients with pelvic pain. *Wiener Klinische Wochenschrift*. 2022;134:11-48.
29. Silberstein SD. Practice parameter: evidence-based guidelines for migraine headache: report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology*. 2000;55(6):754-762.
30. Patel K, Sutherland H, Henshaw J, Taylor JR, Brown CA, Casson AI, Trujillo-Barreton NJ, Jones AKP, Sivan M. Effects of neurofeedback in the management of chronic pain: a systematic review and meta-analysis of clinical trials. *Eur J Pain*. 2020 Sep;24(8):1440-1457.
31. Hesam-Shariati N, Chang WJ, Wewege MA, McAuley JH, Booth A, Trost Z, Lin CT, Newton-John T, Gustin SM. The analgesic effect of electroencephalographic neurofeedback for people with chronic pain: a systematic review and meta-analysis. *Eur J Neurol*. 2022 Mar;29(3):921-936.



32. Wu X, Zheng X, Yi X, Lai P, Lan Y. Electromyographic biofeedback for stress urinary incontinence or pelvic floor dysfunction in women: a systematic review and meta-analysis. *Adv Ther*. 2021 Aug;38(8):4163-4177.
33. Nunes EFC, Sampaio LMM, Biasotto-Gonzalez DA, Nagano R, Lucareli PRG, Politti F. Biofeedback for pelvic floor muscle training in women with stress urinary incontinence: a systematic review with meta-analysis. *Physiotherapy*. 2019;105(1):10-23.
34. Hite M, Curan T. Biofeedback for pelvic floor disorders. *Clin Colon Rectal Surf*. 2021;34(1):56-61.
35. Rao SSC, Go JT, Valestin J, Schneider J. Home biofeedback for the treatment of dyssynergic defecation: does it improve quality of life and is it cost effective? *Am J Gastroenterol*. 2019;114(6):938-944.
36. Zafarmand M, Farmhand Z, Otared N. A systematic literature review and meta-analysis on effectiveness of neurofeedback for obsessive-compulsive disorder. *Neurocase*. 2022 Feb;28(1):29-36.
37. Tan G, Thorny J, Hammond DC et al. Meta-analysis of EEG biofeedback in treating epilepsy. *Clin EEG Neurosci*. 2009;40(3):173-179.
38. Goldenberg JZ, Brignall M, Hamilton M, et al. Biofeedback for treatment of irritable bowel syndrome. *Cochrane Database Syst Rev*. 2019;18(2):2017-2113.
39. Chrousos GP, Boschiero D. Clinical validation of a non-invasive electrodermal biofeedback device useful for reducing chronic perceived pain and systemic inflammation. *Hormones (Athens, Greece)*. 2019;18(2):207-213.
40. Association for Applied Psychophysiology and Biofeedback, Inc. Available from: <https://www.aapb.org/i4a/pages/index.cfm?pageid=3463>. Accessed March 12, 2023.
41. Kondo K, Noonan KM, Freeman M, Ayers C, Morasco BJ, Kansagara D. Efficacy of biofeedback for medical conditions: an evidence map. *Gen Int Med*. 2019;34:2883-2893.
42. Yucha C, Montgomery D. Evidence-based practice in biofeedback and neurofeedback. Wheat Ridge, CO: AAPB;2008.