

SPECIAL ISSUE

Integrating Heart Rate Variability Biofeedback into Mindfulness-Based Therapies

Richard Gevirtz, PhD, BCB

California School of Professional Psychology, Alliant International University, San Diego, CA

Keywords: heart rate variability biofeedback, mindfulness-based therapies, acceptance and commitment therapy, functional gastrointestinal disorders, trauma

Practitioners using heart rate variability biofeedback (HRVB) often must supplement the biofeedback training with other therapeutic techniques. In this article, I describe some of the ways in which my interns and I integrate a mindfulness-based therapy called ACT (acceptance and commitment therapy) into our biofeedback based clinical protocols. I describe some aspects of the HRVB, provide a short overview of ACT, and discuss how they can be combined.

For many disorders, heart rate variability biofeedback (HRVB) is an adjunct to other empirically based therapies. These would include cognitive behavioral therapy (CBT), dialectical behavioral therapy (DBT), cognitive processing therapy (CPT), and more recently, acceptance and commitment therapy (ACT). This is especially true for affective disorders (depression), anxiety disorders (e.g., phobias, generalized anxiety, PTSD), and anxiety-related disorders such as functional gastrointestinal disorders.¹

We have found ACT particularly compatible with HRVB. After getting a thorough history, we begin with the biofeedback components and slowly begin to integrate ACT principles and exercises into the sessions. The first session is an evaluation session, but we delay administering the ACT scales (Gratz & Roemer, 2004; Hayes et al., 2004; Siegling & Petrides, 2014) for a session or two in order to keep the focus on the symptoms and away from more basic psychological mechanisms. For the biofeedback evaluation, we record multiple physiological modalities for a five biofeedback baseline, 2–3 minutes of a stressor or mild exercise, and another 5 minutes of recovery time. For the HRV parameters, we use the Kubios HRV—Heart Rate Variability Analysis software to analyze HRV as a marker of autonomic flexibility (Biosignal Analysis and Medical Imaging Group, 2015). Skin conductance, temperature, and respiration are recorded from the biofeedback system itself.

We look for patterns of vagal withdrawal (Porges, 1995), indicators of high sympathetic arousal, poor vagal recovery, and other telltale physiological markers.

Next we determine the resonance frequency (RF; Lehrer, Vaschillo, & Vaschillo, 2000) for the client. The RF is the breathing rate that produces the greatest heart rate variability. We then send the client home to practice breathing at the RF, with one of the breath pacers or devices available, such as MyCalmBeat (Brain Resource, San Francisco, CA), Breath2-Relax (National Center for Telehealth & Technology, Joint Base Lewis-McChord, WA), Breathe Sync (StillWorks, Breathe Sync Ltd., England and Wales), Inner Balance (HearthMath, Boulder Creek, CA), or EZ-Air Plus (Biofeedback Federation CIC, London, UK). Once we see a well-established ability to regulate the heart rate waveform with slow breathing, we look for skin temperature increases accompanied by skin conductance drops after a few well regulated slow breaths. Figure 1 shows a biofeedback display from a session in which the client is demonstrating good mastery of heart rate variability biofeedback. Our group and Lehrer's group have written extensively about these protocols and applications. A review of HRVB studies was presented in this journal recently (Gevirtz, 2013a, 2013b; Lehrer, 2013a, 2013b; Lehrer et al., 2013).

Acceptance and Commitment Therapy (ACT)

The establishment of the RF serves as a base skill to move on to ACT interventions. ACT is a mindfulness-based therapy created by Steve Hayes and colleagues at the University of Nevada at Reno (Hayes, Strosahl, & Wilson, 2011). They have a helpful website with numerous materials (<https://contextualscience.org>). ACT differs from traditional cognitive therapies in that it posits that the human internal milieu is not as amenable to modification as once thought. Rather than struggle to replace dysfunctional thoughts or beliefs with rational or logical ones, the patient is encouraged to stop struggling and accept the ongoing internal processes as

¹ <https://contextualscience.org>

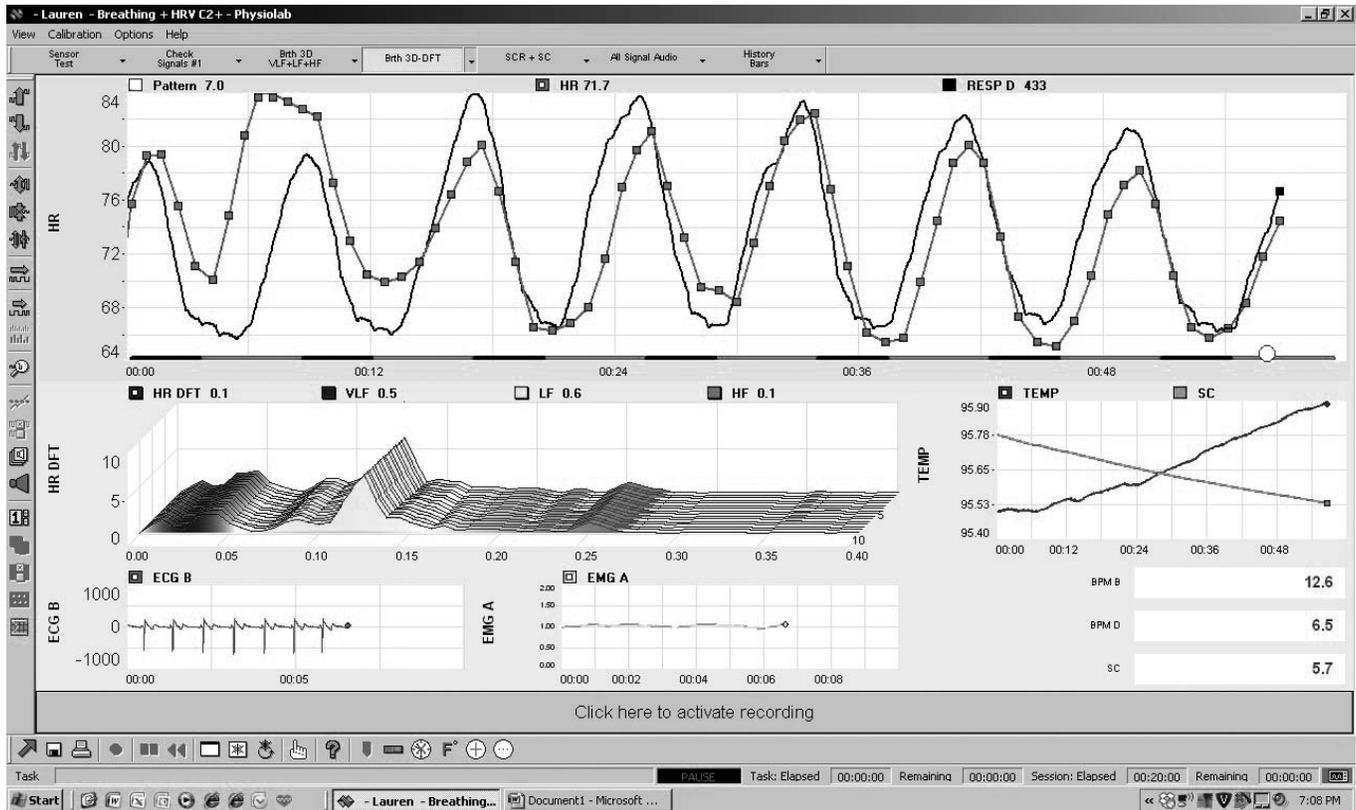


Figure 1. A typical screen shot demonstrating mastery of heart rate variability biofeedback. We look for symmetry between the respiration wave (in blue above) and the heart rate waveform (in red), maximum peak/valley amplitude, and maximum low frequency peak (in green). Positive indicators are the rising temperature and lowered skin conductance (blue and purple) in the lower right hand panel.

inevitable, as well as transient “stories we tell ourselves.” The struggle to avoid pain, discomfort, anxiety, sadness, or other negative processes is replaced by an acceptance-based philosophy in which valued actions, beliefs, and thoughts are the goal for commitment. The version of ACT that we have found to be the most useful is presented in the book by Russ Harris called *The Happiness Trap* (2008). Harris has articulated the six core principles of ACT (see Figure 2). We have developed a mantra for our ACT clients, to capture the spirit of these core principles of ACT: The goal of ACT is “doing good not feeling good.”

As the therapy proceeds from the HRVB skills, these ACT principles are incorporated as appropriate. What follows are some examples of implementing this integration of heart rate variability biofeedback with ACT-oriented principles and therapeutic techniques, with disorders we commonly treat.

Functional Gastrointestinal Disorders

In our clinic, the most frequently seen disorders are functional gastrointestinal disorders. The population varies from 8-year-olds to teenagers to seniors. Amy, age 14 (not her real name),

was referred for severe abdominal pain that contributed to her missing lots of school and led to many medical visits and emergency room trips. The onset for Amy was junior high school and her symptoms had worsened despite elimination diets, medication, and counseling. Her Kubios analysis revealed low heart rate variability (RMSSD was 22, LnHF was 4.6),² leading us to conclude that vagal withdrawal was the mediating physical factor. Psychosocially, Amy was a “nice” kid, a bit shy and socially anxious in some situations. The peer pressures of a large junior high seemed to precipitate a lot of anxiety, worried thoughts, and feelings of inadequacy.

After three sessions of HRVB with home practice, her symptoms were reduced by about 50% and we continued with the HRVB protocol, but now added ACT. We used a number of metaphors and analogies to try and get Amy to be more mindful and to reappraise her inner milieu. For example, we used the Chinese finger puzzle where the harder you pull, the tighter the bands get, to illustrate the

² Both RMSSD and LnHF are statistical indices for heart rate variability. The RMSSD is the root mean square of successive differences between adjacent interbeat intervals (the time periods between heart beats in milliseconds). The LnHF is the natural log transform of high frequency heart rate variability.

The Six Core Principles of ACT:

- **Defusion**
 - *“Relating to your thoughts in a new way, so they have much less impact and influence over you.”*
- **Expansion**
 - *“Making room for unpleasant feelings and sensations instead of trying to suppress them or push them away.”*
- **Connection**
 - *“Connecting fully with whatever is happening right here, right now; focusing on and engaging in whatever you are doing or experiencing.”*
- **The Observing Self**
 - *“A powerful aspect of mind, which has been largely ignored by western psychology until now.”*
- **Values**
 - *“Clarifying and connecting with your values is an essential step for making life meaningful.”*
- **Committed Action**
 - *“A rich and meaningful life is created through taking action...It happens through effective action, guided by and motivated by your values.”*)

Figure 2. The Six Core Principles of ACT (Harris, 2008, pp. 33–34).

futility of struggle. We got her to change her language to say things like “I’m having the thought that if I don’t get an A, I will be a failure.”

A powerful example that was in the news at the time was the actress Lindsay Lohan’s spiral into substance abuse and rehabilitation. We use it to explore whether striving to feel good, avoid pain or discomfort, and aggressively seek positive mood boosts was a viable strategy for a good life. She related to this example and became more open to “being with her anxiety” like an unwelcome, but persistent guest. We find the YouTube videos by Joe Oliver to be very effective with teens and young adults (e.g., www.youtube.com/watch?v=cOSSKArYbZU).

We integrate the breathing-based aspects of the HRVB by asking the clients to use their slow breathing as a mindfulness-enhancing tool. For Amy, this meant catching herself with some anxious thoughts or worries, breathing at seven breaths per minute, and imagining that these thoughts were characters marching from her right ear to her left in a parade. Each thought carried a slogan representing the disturbing thought or belief. Her job was to be a spectator watching the parade, but not a participant in the parade. This seemed to help shorten the vagal withdrawal and return the gut to normal function. At the end of the sixth session, she was symptom free, not free of negative emotions, or anxiety, but functioning at an acceptable level.

Trauma Symptoms

The model proposed by Porges (Dale et al., 2009; Porges, 2011) for PTSD represents another type of situation in which combining ACT and HRVB can be advantageous. The model can be thought of as the “broken brake” model. It is hypothesized that the vagal brake has been affected by one or more traumatic events, such that after an arousal, recovery is hampered. Going downhill with the accelerator stuck and poor brakes is an apt description for many PTSD symptoms. Again, after a baseline resting heart rate (HR) measurement period, the client pedals an exercise bicycle to get HR up about 20%, after which another 5-minute recovery is recorded. Typically, the trauma victims show poor recovery (Dale et al., 2009). The elevated HR persists in spite of efforts to relax and recover.

The therapy begins with HRVB as above. It is helpful to show the clients their Kubios file and designate a target for training. During the early sessions, trauma scripts are developed, but always in the context of having the HRVB safety net.

Once the client demonstrates some recovery in autonomic flexibility, prolonged exposure with ACT begins. Prolonged exposure (PE) to trauma-related images is another well-documented therapy for PTSD. Again the early stages are characterized by defusion interventions, i.e., getting the client to see that the storm of emotions and

symptoms are a story the brain is telling him or her; disturbing, yes, but not necessarily true. We emphasize the role of courage (especially in military veterans). Allowing the horrible images, feelings, and beliefs to be there (expansion), yet moving forward with value-based actions, takes a great deal of courage.

The therapist can monitor the physiological and subjective arousal and intervene with the self-soothing slow breathing after sufficient exposure. In our experience, proficiency in the slow breathing techniques enhances mindfulness abilities. Dalenberg (2014) has found that this combination of ACT, PE, and HRVB speeds the extinction of unwanted memories and produces about a 20% gain in therapeutic outcomes (Dalenberg, 2014).

Conclusion

Overall, we have found that combining ACT with HRVB is a powerful tool for treating anxiety and stress related disorders. With trauma, we also add PE to the combination of HRVB and ACT. The biofeedback seems to be a seamless fit with ACT interventions. We hope to continue to research this idea in more rigorous trials to determine exactly how much each component contributes and whether the components are synergistic.

References

- Biosignal Analysis and Medical Imaging Group. (2015). Kubios HRV—Heart rate variability analysis software. Joensuu, Finland: University of Eastern Finland. Available at <http://kubios.uef.fi/>
- Dale, L. P., Carroll, L. E., Galen, G., Hayes, J. A., Webb, K. W., & Porges, S. W. (2009). Abuse history is related to autonomic regulation to mild exercise and psychological wellbeing. *Applied Psychophysiology and Biofeedback, 34*(4), 299–308. doi:10.1007/s10484-009-9111-4
- Dalenberg, C. (2014). *The treatment of trauma: Integrating HRV and cognitive behavior therapy*. Paper presented at the Association of Applied Psychophysiology and Biofeedback Meeting, Savannah, GA.
- Gevirtz, R. (2013a). The nerve of that disease: The vagus nerve and cardiac rehabilitation. *Biofeedback, 41*(1), 32–38.
- Gevirtz, R. (2013b). The promise of heart rate variability biofeedback: Evidence-based applications. *Biofeedback, 41*(3), 110–120.
- Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment, 26*(1), 41–54.
- Harris, R. E. (2008). *The happiness trap: How to stop struggling and start living*. Boston, MA: Trumpeter.
- Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2011). *Acceptance and commitment therapy* (2nd ed.). New York, NY: Guilford.
- Hayes, S. C., Strosahl, K., Wilson, K., Bissett, R., Pistorello, J., Toarmino, D., Polusny, M. A., et al. (2004). Measuring experiential avoidance: A preliminary test of a working model. *The Psychological Record, 54*, 553–578.
- Lehrer, P. (2013a). History of heart rate variability biofeedback research: A personal and scientific voyage. *Biofeedback, 41*(3), 88–97.
- Lehrer, P. (2013b). How does heart rate variability biofeedback work? Resonance, the baroreflex, and other mechanisms. *Biofeedback, 41*(1), 26–31.
- Lehrer, P., Vaschillo, B., Zucker, T., Graves, J., Katsamanis, M., Aviles, M., & Wamboldt, F. (2013). Protocol for heart rate variability training. *Biofeedback, 41*(3), 98–109.
- Lehrer, P. M., Vaschillo, E., & Vaschillo, B. (2000). Resonant frequency biofeedback training to increase cardiac variability: Rationale and manual for training. *Applied Psychophysiology and Biofeedback, 25*(3), 177–191.
- Porges, S. (2011). *The polyvagal theory*. New York, NY: Norton.
- Porges, S. W. (1995). Cardiac vagal tone: A physiological index of stress. *Neuroscience and Biobehavioral Reviews, 19*(2), 225–233.
- Siegling, A. B., & Petrides, K. V. (2014). Measures of trait mindfulness: Convergent validity, shared dimensionality, and linkages to the five-factor model. *Frontiers in Psychology, 5*, 1164. doi:10.3389/fpsyg.2014.01164



Richard Gevirtz

Correspondence: Richard Gevirtz, PhD, Distinguished Professor, California School of Professional Psychology, Alliant International University, 10455 Pomerado, San Diego, CA 92131, email: Rgevirtz@Alliant.edu.
