Heart Rate Variability Training

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Fred Shaffer, Ph.D.

Fred Shaffer, Ph.D. is Professor of Psychology at Truman State University and founded an innovative biofeedback and applied psychophysiology program in 1977. He was a 2005 recipient of the AAPB Sheila Adler Distinguished Service Award. He is the producer and author of Biofeedback Tutor, a multimedia training program developed for the BCIA General Examination in Biofeedback. His research interests focus on heart rate variability and respiratory self-regulation.

What is Heart Rate Variability?

By variability we mean changes in the interval or distance between one beat of the heart and the next. The interbeat interval (IBI) is the time between one R-wave (or heart beat) and the next, in milliseconds. The IBI is highly variable within any given time period. Multiple biological rhythms overlay one another to produce the resultant pattern of variability. Interbeat interval variations, or heart rate variability, have relevance for physical, emotional, and mental function. Many people confuse Heart Rate with Heart Rate Variability. The human heart is a bio-electrical pump beating at an ever changing rate: it is not like a clock that beats at a steady, unchanging rate. This variability in heart rate is an adaptive quality in a healthy body.

How is Heart Rate Variability measured?

One measure of heart rate variability is the difference between the highest heart rate and the lowest heart rate within each cardiac cycle, measured in beats per minute. This index is called “HR Max – HR Min.” A second

In this interview, Dr. Don Moss and Dr. Fred Shaffer bring the insights that they have acquired through their many years of research and practice to other health professionals and introduce some of the key techniques being used in Heart Rate Variability (HRV) biofeedback training. The body’s autonomic nervous system (ANS) governs many of the body’s internal functions, through its two branches: the sympathetic branch of this ANS activates or increases the heart’s action, while the parasympathetic branch acts as a brake slowing the action of the heart. The vagus nerve plays a role in the parasympathetic braking action. The balance between this throttle and brake system produces an ongoing oscillation, an orderly increase and decrease in heart rate. These autonomic inputs are mediated by two “pacemakers” in the heart, the sinoatrial (SA) and atrioventricular (AV) nodes, which are responsible for heart rhythms. The SA node initiates an electrical signal which begins each cycle of the heart’s pumping action. This signal passes through the AV node which spreads the electrical current through the ventricles of the heart. A variety of factors, including breathing, pressure sensors (baroreceptors) in the arteries, the body’s thermal regulation, and anxious thinking, increase specific rhythms in heart activity. The overall process of heart function is the end product of these component rhythms. Higher heart rate variability seems to indicate an optimal cooperation between the sympathetic and parasympathetic nervous system.

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index of Heart Rate Variability, widely used in medical research is the Standard Deviation of the N-to-N interval. The N-to-N interval is the "normalized" beat-to-beat interval. The SDNN is the standard deviation of those intervals, a measure of their variability. The SDNN is expressed in milliseconds (ms). Finally, a third index of variability, more reliable in the short term, is called pNN50. This index measures what percent of the Interbeat Intervals differ from neighboring intervals by 50 milliseconds or more. The pNN50 is expressed in percentages.

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Can we train individuals to increase the variability of their Heart Rate and is there an ideal value for HRV?

Scientific study of the variability in heart rate is fairly recent, and only in the past ten years did it become possible to train human beings to change the variability in heart rhythms. Biofeedback practitioners have found that biofeedback training can increase HRV, through several parallel training pathways. The practitioner initially guides the subject to acquire three basic skills: 1) relax physically and emotionally, 2) reduce anxious thoughts and negative emotions, and 3) engage in smooth full diaphragmatic breathing. Next, the trainee learns to recognize and produce the smooth sinusoidal wave forms (RSA waveforms) in which respiration and heart rate co-vary in a near-phase or complete phase relationship. HRV biofeedback can reinforce breathing in the 5-7 breaths per minute range, and reinforce the production of a dominant spike in HRV at around 0.1 Hz.

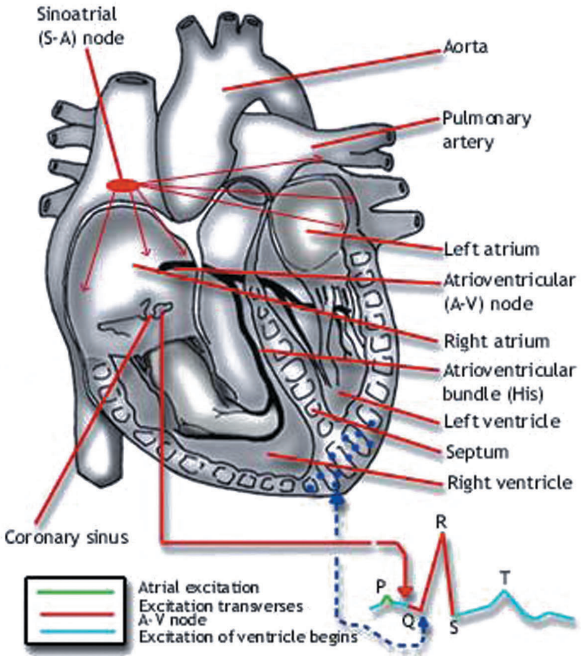


Photo Courtesy of the Biofeedback Tutor

Current research suggests that each individual has a "resonant frequency" at which heart rate variability is the greatest, and this resonant frequency can be measured by biofeedback instruments. While there is no uniform "ideal value" for all persons, this resonant frequency is most frequently produced by persons in a relaxed mental state, with a positive emotional tone, breathing diaphragmatically at a rate of about 5-7 breaths per minute. Relaxed breathing at around six breaths per minute produces a spike of heart rate variability at around 0.1 Hz. Remember that one tenth of a hertz equals one tenth of a cycle per second, so that 0.1 Hz equals six cycles per minute. The other measures of HRV also tend to maximize when heart rate change is dominated by rhythms in this Low Frequency range. In this way, a trainee in HRV biofeedback can be directly reinforced for increasing one of the variability indices (HR Max – HR Min, SDNN, or pNN50).

Is there any current or ongoing research to support HRV biofeedback?

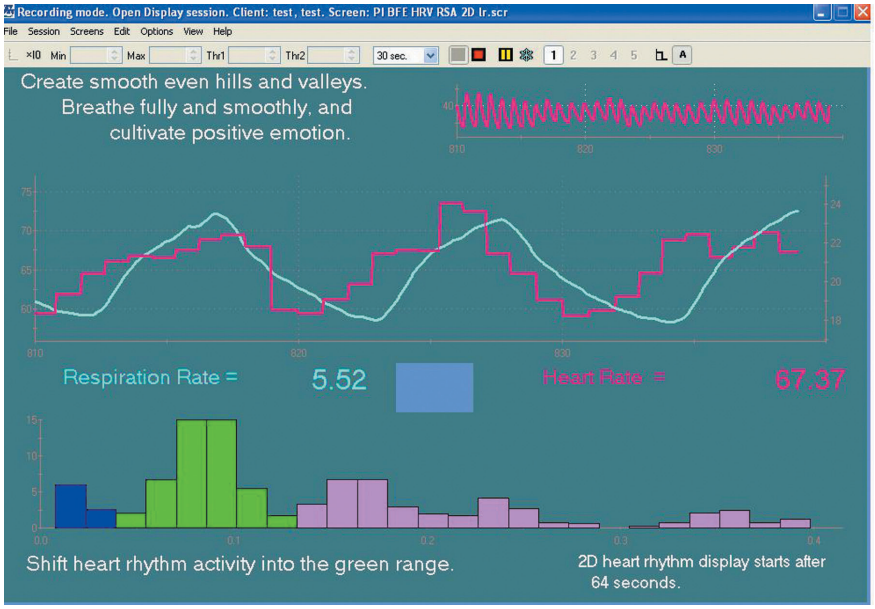
Psychophysiological research suggests that these frequency ranges reflect different biological influences. The high frequency range is associated with parasympathetic pathways, the influences of respiration in normal frequencies on vagal tone. The low frequency range is associated with the influence of blood pressure (baroreceptors) on heart rhythms, and meditative/slow breathing augments this range. The very low frequency range is associated with sympathetic activation, or more probably the withdrawal of parasympathetic braking, and also the influences of visceral and thermal regulation. Rumination and worry augment this range. Finally, the ultra low frequency range is associated with the slower-acting biological influences. Several clinical findings show the importance of the heart's variability. Changes in the rhythms of the heart occur before a fetus goes into distress,

and may predict sudden infant death. Lower variability in heart rate predicts a greater risk for death after a heart attack and death from all causes in adults, especially sudden death. Studies have also shown that clinical depression lowers heart rate variability.

What is the relationship between Heart Rate Variability and Biofeedback?

Heart Rate Variability Biofeedback, or HRV biofeedback, is a new technique for training human beings to change the variability and dominant rhythms in their heart activity. The use of HRV biofeedback began in Russia, where it was applied to the treatment of asthma and many other conditions. Research is now going on in many sites within the United States, applying HRV biofeedback to a variety of medical and psychiatric conditions, including: anger, anxiety disorders, asthma, cardiovascular conditions, chronic obstructive pulmonary disorder, irritable bowel syndrome, chronic fatigue, and chronic pain.

Biofeedback training can teach patients to increase the percentage of total HRV in specific frequency ranges. To date, it appears optimal to increase the amount of heart rate change in the Low Frequency Range. Evgeny Vaschillo, a Russian physiologist, hypothesizes that there is a "resonant frequency," native to each organism, which is optimal for overall health. For most persons that resonant frequency involves a dominance of heart rate change in the Low Frequency (LF) range, around 0.1 Hz. HRV biofeedback can therefore guide and reinforce



trainees for shifting their overall heart rate variability into the LF range.

Can you tell me a little about your BFE Suite on HRV Training and what makes it so useful to professionals that want to work with Heart Rate Variability Biofeedback?

The Suite has been designed to help newcomers to the field to apply what has been demonstrated by both research and experience. It includes specialized software display screens to support a variety of convergent training strategies to produce increased heart rate variability. One of the things we are most pleased about with the suite is that it also includes a clinical guide that clinicians can use to get started right away in this exciting field. The software and documentation in the suite teach the techniques necessary for increasing heart rate variability. HRV biofeedback can be of particular value to psychologists and other health practitioners and therapists.

Does Heart Rate Variability change with age?

As human beings age or suffer illness, the total variability in heart rate is reduced, and the risk of illness and death increases. Twenty year olds often show a swing of twenty or more points between the high and low points in their heart rates. Persons over 50 often show changes of ten beats or less. Persons who are more physically active show a wider range between their maximal and minimal heart rate. HRV biofeedback can enable the individual to increase this variability in heart rate, sometimes producing a range of fifty beats a minute during training. HRV biofeedback training can focus on increasing the HR Max –HR Min index.

"Heart Rate Variability Biofeedback is a new technique for training human beings to change the variability and dominant rhythms in their heart activity."

NEW

Physiology Suite features:

- Skin-conductance driven relaxation script with audio induction track
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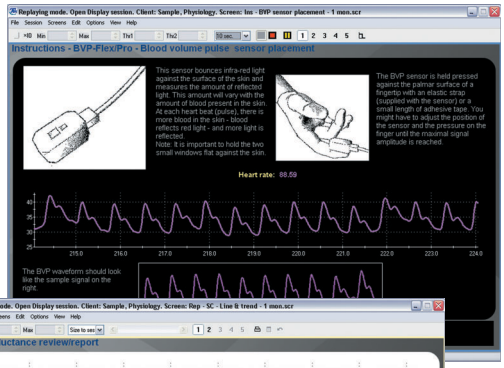

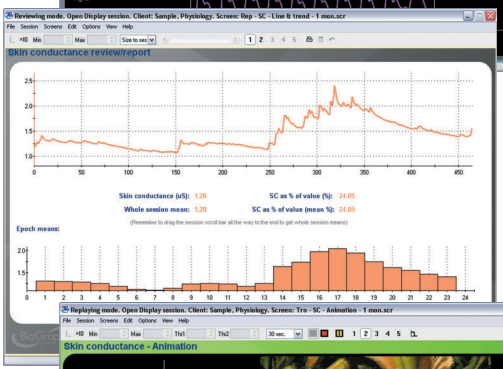

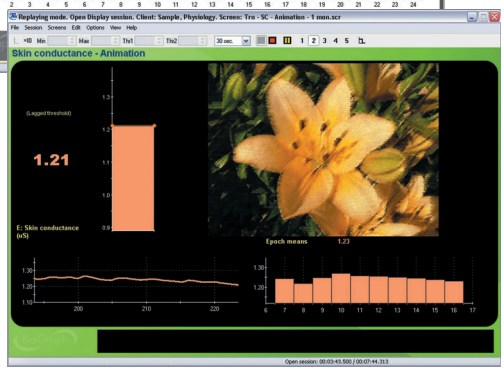

Physiology SUITE™

The Physiology Suite contains a complete set of standard biofeedback tools to get a total physiological perspective on your client's sympathetic and parasympathetic processes, including: Temperature, Skin Conductance, Surface EMG, Respiration and Heart rate variability (HRV).

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