Biofeedback
Volume 36, Issue 1, pp. 30–34

HRV: THE MANUFACTURERS AND VENDORS SPEAK

From Depletion to Renewal: Positive Emotions and Heart Rhythm Coherence Feedback

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Keywords: stress, positive emotion, heart rate variability, HRV, physiological coherence

The author is director of research for the Institute of HeartMath, which has conducted the majority of the research leading to the identification of the psychophysiological coherence state. Consequent to this was the development of the portable heart rate variability device, the emWave, and the computer-interfaced heart rate variability instrument, the emWavePC. The article presents an approach to stress management and wellness that emphasizes identifying negative and draining emotions and replacing them with positive emotions. The HeartMath model introduces heart-based, emotion-focused strategies and engages the "power of the heart's intent" for increasing positive emotional experiences, improving relations with others, and increasing overall well-being. Heart rate variability biofeedback provides an adjunctive intervention, restoring physiological coherence and supporting emotional self-regulation.

Introduction: The Stress of Life

"It's just stress." How many times have you uttered those words to yourself to dismiss an emotional outburst, forgetfulness, headache, pain, or illness?

The term *stress* has become one of the most widely used words in the everyday vernacular. People describe themselves as stressed when stuck in traffic or when experiencing the dissolution of a long-term relationship. Preparing for an examination, having difficulty communicating with a coworker, dealing with serious illness in the family, and adjusting to new living or working conditions can all be stressful.

Stress is not just some benign complaint. Rather, it's a powerful risk factor for disease and an important predictor of health. According to a recent article in *JAMA* (Cohen, Janicki-Deverts, & Miller, 2007), there is a documented link between stress and an increased risk for heart attacks, depression, cancer, and the progression of HIV and AIDS. Notably, an accompanying article in the same issue shows that workplace stress may be as bad for your heart as smoking and high cholesterol (Aboa-Eboule et al., 2007).

Stress and the Emotions

In addition to stress having important effects on our physical heath, the research literature is very clear in pointing to a negative relationship between stress and overall well-being. But what defines the essence of the experience of stress? In essence, stress can be thought of as *emotional unease*. From a psychophysiological perspective, emotions are the main ingredient in one's experience of stress; indeed, it is the emotions—feelings such as anxiety, irritation, frustration, lack of control, or hopelessness—that are truly what we are experiencing when we describe ourselves as stressed.

Many contemporary scientists believe that the quality of feeling and emotion we experience is rooted in the underlying state of our physiological processes. This view is well expressed by neuroscientist Antonio Damasio (2003) in the following statement:

> …there are organism states in which the regulation of life processes becomes efficient, or even optimal, free-flowing and easy. This is a well established physiological fact. It is not a hypothesis. The feelings that usually accompany such physiologically conducive states are deemed "positive," characterized not just by absence of pain but by varieties of pleasure. There also are organism states in which life processes struggle for balance and can even be chaotically out of control. The feelings that usually accompany such states are deemed "negative," characterized not just by absence of pleasure but by varieties of pain. The fact that we, sentient and sophisticated creatures, call certain feelings positive and other feelings negative is directly related to the fluidity or strain of the life process. (p. 131)

Whereas mental processes clearly play a role in emotional experience and stress, it is well recognized that thoughts carrying an "emotional charge" are those that tend to perpetuate in consciousness. It is also emotions—more than thoughts alone—that activate and drive the physiological changes that correlate with the stress response.

Emotional Self-Regulation: Cultivating Positive Emotion

We have found that the key to optimal well-being is directly related to our ability to self-regulate our emotional experience. Simply said, the emotions we tend to call negative do indeed disrupt optimal physiological and mental functions. Even short periods of these negative emotions lead to depletion of the various physiological systems. In other words, they drain our energy. On the other hand, the emotions we tend to call positive facilitate a wide range of physiological functions, renew our energy, and optimize the body's natural regenerative processes. The tools and technologies developed at the Institute of HeartMath are thus designed to help people notice and identify when they are stressed, then replace the draining emotions and attitudes with ones that add energy, clarity, and more balanced perceptions. This often requires neutralizing the emotional response and removing the significance and drama that is fueled by the cognitive perceptions.

Many individuals believe that if they could just learn to relax then they would be healthier and happier. Relaxation and breathing techniques are important and beneficial in that they calm the system and temporarily draw attention away from distressing feelings and reduce physiological arousal. In fact, breathing at the appropriate rhythm facilitates both a physiological and an emotional shift, and for this reason, heart-focused breathing is the first step in a number of the emotional refocusing and restructuring techniques developed at HeartMath. Although the breathing step is helpful for calming, to sustain shifts in ingrained attitudes and strong emotions takes much more than that. This is why we focus on teaching people how to increasingly shift the significance out of negative emotions and to build replacement attitudes. This is done by learning to engage the power of the heart's intent. The important part of the process is learning how to shift attention to the heart and activate a positive feeling or attitude replacement. HeartMath techniques are designed to help people shift feelings, not just thoughts. Once the feelings shift, then the thoughts automatically become more positive.

In most cases, the mind alone doesn't have the power to shift emotional stress or change negative attitudes. We have found that the key to sustained attitude and behavioral change requires transformation of the deeper, recurring physiological and emotional patterns that give rise to stress-producing feelings. Without these more fundamental changes at the emotional and physiological levels, any relief from stress and the resulting system depletion and reduced well-being are likely to be short-lived.

The Role of Heart Rate Variability Feedback

We have found that heart rate variability (HRV) feedback can significantly help clients in learning how to use and apply the positive-emotion–based refocusing and restructuring techniques.

In previous articles in this magazine (McCraty, 2002; McCraty, 2005; McCraty & Childre, 2001), and in numerous other publications, I have discussed the "psychophysiological coherence state" and how it reflects a global state of optimal function (for a detailed definition of coherence and the details of the mathematical measurement of the coherent state, see McCraty, Atkinson, Tomasino, and Bradley [2006]). This state is characterized by increased synchronization, harmony, and efficiency in the interactions within and among the physiological, cognitive, and emotional systems. Coherence can be activated naturally with intentional shifts to a positive emotional state, such as appreciation, compassion, and love (McCraty, 2004; McCraty & Childre, 2004; McCraty, Barrios-Choplin, Rozman, Atkinson, & Watkins, 1998). This shift reflects increased synchronization in higher-level brain systems and in the activity occurring in the two branches of the autonomic nervous system (ANS), as well as a shift in autonomic balance toward increased parasympathetic activity (McCraty, 2005; Tiller, McCraty, & Atkinson, 1996). These observed linkages between positive emotions and increased physiological coherence and efficiency may provide an important insight into the mechanism that explains the growing number of documented correlations between positive emotions (McCraty et al., 2006), increased cognitive flexibility, and creativity (Isen, 2002; Simonton, 2002), broadened thought-action repertoires, increased personal resources (Fredrickson, 2002), improved health, and increased longevity (Danner, Snowdon, & Friesen, 2001; Levy, Slade, Kunkel, & Kasl, 2002; Ostir, Markides, Black, & Goodwin, 2000).

In addition to its important role in a biofeedback context, HRV and heart rhythm pattern analysis also provide powerful tools for assessing the impact of stress on depletion of one's physiological systems and well-being, as well as measuring the effects of interventions on renewing physiological and emotional systems. HRV is more than an assessment of heart rate; it is a much deeper assessment of the complex interaction of the heart with multiple body systems.

The amount of HRV is related to our age, with younger individuals having higher levels of HRV than older individuals (Umetani, Singer, McCraty, & Atkinson, 1997). Abnormally low HRV, relative to one's age, is a strong and independent predictor of future health problems, including all causes of mortality (Levy et al., 2002). In addition, HRV is considered a psychophysiological marker of emotion regulation and psychological adjustment. In studies of infants and children, the amount of HRV has been demonstrated to reflect a wide range of emotional expressiveness such as temperamental reactivity, empathic responding, social competence, attentional capacity, and aggression. In adolescents and adults, low HRV has been linked to hostility, aggression, depression, panic, and eating disorders.

Thus, HRV is an important indicator of both physiological resiliency and behavioral flexibility, reflecting an individual's capacity to adapt effectively to stress and environmental demands (Beauchaine, 2001). Although too much instability is detrimental to efficient physiological functioning, too little variation also can be pathological. An optimal level of variability within an organism's key regulatory systems is critical to the inherent flexibility and adaptability that epitomize healthy, coherent function and well-being that span developmental stages from infancy to adulthood.

For example, low HRV is associated with behavior problems and difficulties with emotion regulation in toddlers and preschoolers (Calkins, Graziano, & Keane, 2007); children who have been exposed to domestic violence in families (Katz, 2007); adults with major depression (Rechlin, Weis, Spitzer, & Kaschka, 1994); adults with bipolar depression (Cohen et al., 2003); and adults with generalized anxiety (Friedman, 2007; Fuller, 1992; Monk et al., 2001). Additionally, low HRV and the effects of depletion on the ANS have been associated with numerous medical conditions including congestive heart failure (Saul et al., 1988), diabetes (Lindmark, Buren, & Eriksson, 2006; Lindmark et al., 2005; Lindmark, Wiklund, Bjerle, & Eriksson, 2003), hypertension (Maver, Strucl, & Accetto, 2005), weight gain (Arrone, Mackintosh, Rosenbaum, Leibel, & Hirsch, 1997), and alcoholism (Ingjaldsson, Laberg, & Thayer, 2003).

Failure to inhibit the impulse to eat is in part responsible for obesity, for example, and failure to control an angry outburst can result in interpersonal aggression. Unintentional failures in self-regulation such as these compromise well-being, whereas the ability to meet self-regulatory demands such as inhibiting impulses, making decisions, persisting at difficult tasks, and controlling emotions contribute to enhanced well-being and quality of life.

For most people, there is no prior warning of a problem in self-regulation and there is no evidence of an imminent lapse in self-regulatory control. However, now that HRV can be monitored more easily, it is possible to predict such lapses before they occur.

Ingjaldsson and colleagues (2003) have demonstrated that the self-regulation necessary for inhibiting impulses and persisting at difficult tasks is directly related to increases in HRV. Therefore, it is now quite promising to consider the possibility that with monitoring HRV, one may better adhere to tasks that require self-regulation and therefore improve those areas of one's life that lead to increased overall wellness.

A good example of this comes from a U.S. Department of Education–funded study we recently completed that assessed HRV parameters in a subgroup of 136 tenth-grade high school students (Bradley et al., 2007). This study's primary purpose was to investigate the efficacy of the HeartMath emotional self-regulation tools facilitated by use of the emWave heart rhythm coherence feedback system in reducing stress and anxiety and improving emotional well-being, quality of relationships, and academic performance in public school students. This involved determining the magnitude, correlates, and consequences of stress and test anxiety in a large sample of students and investigating the degree to which the intervention had a positive effect on students in an experimental group when compared with those in a control group.

Results from the HRV aspects of the study provided compelling evidence for the hypothesis of a causal link between increased psychophysiological coherence and the cognitive functions central to learning and test taking.

The data show that when students self-manage their stress using coherence-building methods, it enables them to achieve both a significant reduction in test-related anxiety and a corresponding improvement in standardized test scores. Most importantly, results from the postintervention experiment demonstrate that the ability to self-activate coherence is associated with significant reductions in test anxiety and corresponding improvements in measures of emotional disposition. Furthermore, students in the experimental group exhibited increased HRV and heart rhythm coherence during the resting baseline period in the postintervention experiment—even without conscious use of the emotional restructuring tools. This suggests that through their consistent use of the tools over the study period, these students had instantiated a healthier, more harmonious, and more adaptive pattern of psychophysiological functioning as a new baseline or norm.

In other words, the practice of shifting to the psychophysiological coherence state results in a system-wide repatterning wherein the coherent pattern becomes established in the neural architecture as a new, stable baseline or norm, which the system then strives to maintain. This shows that unhealthy or maladaptive patterns can be progressively replaced with ones that foster increased physiological efficiency, mental acuity, and emotional stability. Moreover, even when one experiences stress, challenge, or emotional instability, the familiar, coherent, stable state is more quickly and easily accessible (Bradley et al. 2007).

Conclusion

To summarize, emotional and psychological coherence serves to replenish the individual's cognitive and emotional resources, which are essential to maintaining wellness; the state of desynchronization, which is associated with negative emotions, results in a depletion of the nervous system and energetic resources, and lower overall HRV. This desynchronization in the brain systems and ANS, if sustained, taxes the nervous system and bodily organs, impeding the efficient synchronization and flow of information throughout the psychophysiological systems. This, in turn, results in cortical inhibition that impairs cognitive functions and diminishes one's ability to think clearly, to discriminate among behavioral choices, and to self-regulate emotions (McCraty et al., 2006).

Although the process of self-activating positive emotions and shifting to the psychophysiological coherence mode clearly leads to immediate benefits by helping to transform stress in the moment it is experienced, it also can contribute to long-term improvements in emotion-regulation abilities and emotional well-being, which ultimately affect many aspects of one's life. This type of "emotional self-responsibility" is consistent with the predominant view of wellness, because it focuses on the individual's self-regulation skills as a critical component of lifestyle change. With consistency of practice, these patterns become increasingly familiar to the brain. Thus, these new, healthy patterns become established as a new baseline or reference point that the system then strives to maintain. Heart-based, positive emotion-focused techniques are designed to help people self-induce and sustain states of well-being and have proven to be effective in a variety of settings. The study of the relation of the heart to the study of wellness remains one of the exciting frontiers in the field of biofeedback, self-regulation, and positive psychology.

In a future study currently in the planning stage, we hope to evaluate the effectiveness on both personal and community wellness of a community-based intervention that teaches heart-based living skills. We anticipate that an individual's growth in self-regulation will result in greater connectedness with others and that this will contribute to social increased harmony, with self-centered behaviors eventually being replaced by more altruistic cooperative behaviors. As more individuals make the efforts required to maintain true wellness in their lives, we anticipate that the resiliency and overall quality of life of the community at large will benefit as well.

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