

# FEATURE

## Enhancing Emotional, Social, and Academic Learning With Heart Rhythm Coherence Feedback

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*Heart rhythm coherence biofeedback is an exciting new technology that has broad-based applications in educational contexts for improving emotional, social, and academic competencies. Using this technology to facilitate the learning and practice of positive emotion-focused techniques, students learn to enter a state of psychophysiological coherence—a highly efficient functional mode associated with increased nervous system harmony, enhanced emotional stability, and improved cognitive performance. Classroom-based programs incorporating this intervention have facilitated improvements in emotional health, social behaviors, and academic performance in diverse student populations.*

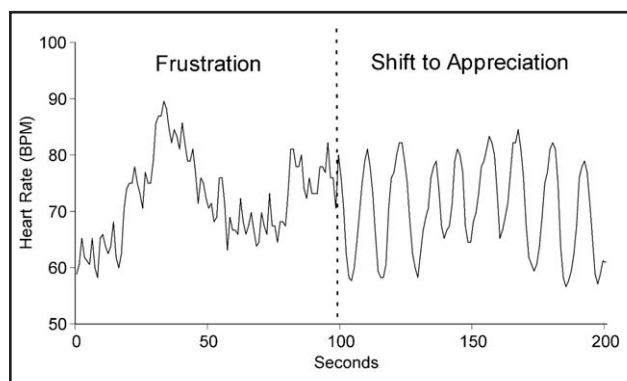
With the passage of the federal No Child Left Behind legislation, increasing student academic performance has risen to the top of both local and national education agendas. However, even as pressures to improve academic performance continue to increase, children are increasingly coming to school emotionally unprepared to learn. This is frequently compounded by the lack of a healthy social and emotional environment *within* the school to support, motivate, and emotionally engage students. As research has begun to illuminate the important connections between emotions, learning, and performance, it has become apparent that effective classroom-based interventions are needed to foster and integrate children's emotional, social, and academic development in order to provide them with tools and skills needed to increase self-awareness and emotional self-management; promote effective communication; practice healthy, responsible behaviors; and build functional, collaborative relationships. Heart rhythm coherence biofeedback is increasingly being used in school settings as an engaging and effective tool to help achieve these ends.

### **Psychophysiological Coherence: Getting "In Sync"**

Research conducted over the past decade by the Institute of HeartMath has provided new insight into the physiology

of emotions, learning, and performance. It is well known that emotional stress negatively affects learning and performance. More specifically, sustained stress and negative emotions result in the desynchronization of brain and nervous system activity, which in turn inhibits higher cognitive processes necessary for functions such as attention, memory recall, abstract reasoning, problem solving, and creativity. Thus, when students come to school with high levels of emotional stress, the resulting "inner noise" impairs the very cognitive resources needed for learning, memory, and effective academic performance.

In contrast, our research indicates that the physiological activity associated with sustained positive emotions enhances synchronization of neurological activity and improves the cognitive functions that generate rational thought, creativity, and intentional action. In essence, we have found that positive emotions give rise to a distinct mode of physiological functioning, termed *psychophysiological coherence*. Physiological correlates of this mode include a smooth, sine wave-like pattern in the heart rate variability trace (heart rhythm coherence), which reflects increased synchronization between the activity in the two branches of the autonomic nervous system; a shift in autonomic nervous system balance toward increased parasympathetic activity; increased heart-brain synchronization (the brain's rhythms become more synchronized to the heartbeat); increased vascular resonance; and entrainment among diverse physiological oscillatory systems. These physiological changes result in a highly efficient state in which the body, brain, and nervous system function with increased synchronization and harmony—in simple terms, a state of being highly "in sync." Several independent studies have shown that increasing psychophysiological coherence is associated with improvements in cognitive performance on tasks requiring focus and attention, discrimination, quick and accurate reaction, and memory. Moreover, the coherence mode is also associated with increased emotional stability and a reduction in the perception of stress and negative emotions (McCraty, Atkinson, Tomasino, & Bradley, 2005).



**Figure 1.** Shift to coherence. Real-time heart rate variability pattern of an individual using a HeartMath positive emotion refocusing technique (at the dotted line) to shift from a state of frustration to a feeling of appreciation, which is associated with psychophysiological coherence.

### Coherence-Building Tools

Based on this research, the Institute of HeartMath has developed a set of positive emotion-focused techniques that help people learn to self-generate and sustain psychophysiological coherence and its associated benefits (Childre & Martin, 1999; Childre & Rozman, 2005). Studies have shown that the practice of these techniques lowers stress, decreases cortisol and increases dehydroepiandrosterone (DHEA), and leads to significant improvements in many aspects of psychosocial functioning and performance across diverse populations. These techniques have also been shown to produce significant improvements in health status in various clinical populations (for a summary see McCraty, Atkinson, & Tomasino, 2001; McCraty & Childre, 2002).

In brief, HeartMath techniques combine a shift in the focus of attention to the area around the heart (where many people subjectively feel positive emotions) with the intentional self-induction of a sincere positive emotional state, such as appreciation. Such a shift in focus and feeling serves to increase heart rhythm coherence and nervous system harmony, which results in a change in the pattern of neurological signals sent to the cognitive and emotional centers in the brain. This, in turn, facilitates higher cognitive faculties and emotion regulation abilities that are normally compromised during stress or negative emotional states, thus sharpening one's discernment abilities; increasing resourcefulness; and often enabling problematic issues, interactions, or decisions to be assessed and dealt with from a broader, more emotionally balanced perspective.

Research suggests that enduring benefits of these techniques stem from the fact that as people learn to

generate psychophysiological coherence with increasing consistency, *a system-wide repatterning process occurs*, whereby the associated synchronized, harmonious patterns of activity become ever more familiar to the brain and nervous system. These patterns thus become established in the neural architecture as a new, stable baseline or norm, which the system then strives to maintain. The result is that unhealthy or maladaptive patterns are 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 (McCraty, in press; McCraty & Childre, 2002).

### Heart Rhythm Coherence Biofeedback Training

Heart rhythm coherence biofeedback training is a powerful tool to assist students in using positive emotion-focused techniques effectively and learning to self-generate increased coherence. Psychophysiological coherence, measured by the degree of heart rhythm coherence, can be noninvasively monitored, quantified, and facilitated using practical technologies adaptable for classroom and counseling settings. One such device is the Freeze-Framer heart rhythm feedback and coherence-building system (Quantum Intech, Boulder Creek, CA). This interactive hardware/software system monitors and displays individuals' heart rate variability patterns in real time as they practice the positive emotion-focused techniques taught in an included tutorial program. Using a fingertip or earlobe sensor to record the pulse wave, the Freeze-Framer plots changes in heart rate on a beat-to-beat basis. As students practice the techniques, they can readily see and experience the changes in their heart rhythm patterns, which generally become smoother and more sine wave-like as they feel appreciation and other positive emotions (see Figure 1). This process reinforces the natural association between the coherence mode and positive feelings. The real-time physiological feedback also essentially takes the guesswork out of the process of self-inducing a positive emotional state, resulting in greater consistency and effectiveness in practicing emotional shifts.

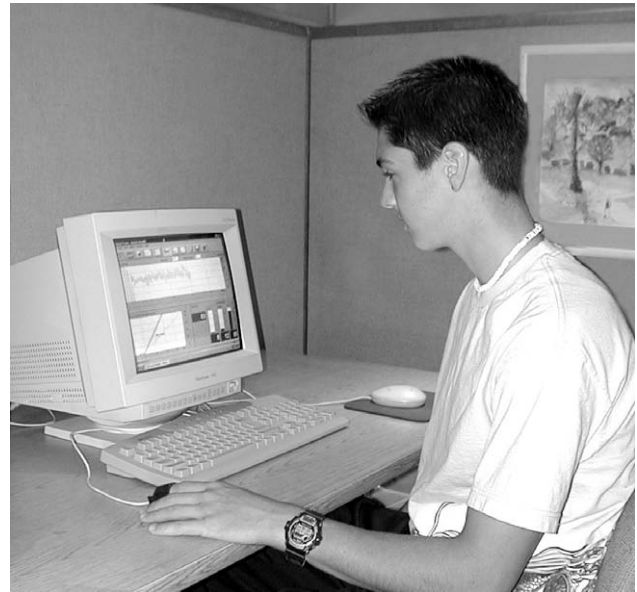
The software also analyzes the heart rhythm patterns and calculates a coherence ratio for each session. The coherence level is fed back to the user as an accumulated score or success in playing one of three enjoyable games designed to reinforce the emotion-refocusing skills.

Finally, the software includes a multiuser database to store results and track users' progress.

Because this technology uses only a simple pulse sensor and involves no electrode hook-up, it is extremely versatile, time-efficient, and easy to use, and thus readily adaptable for use in educational settings. In addition, children are generally easily engaged by their ability to make an immediate connection between the changes in their heart rhythm pattern and corresponding changes in their emotional states. The audiovisual tutorial teaching the HeartMath tools and the three interactive games included with the Freeze-Framer also facilitate the system's use in educational applications. This system has proven engaging and effective for children of widely diverse sociocultural backgrounds and academic levels, and it has also been used with great success in working with special education students and children with attention-deficit/hyperactivity disorder (ADHD). Teachers using the system in their classes have frequently reported a noticeable positive shift in classroom dynamics, one toward reduced tension, conflict, and distractibility accompanied by greater calmness, focus, attention, and cooperation. In some cases, such shifts have been followed by striking improvements in students' learning and academic performance over a very brief period of time (Arguelles, McCraty, & Rees, 2003; Figure 2).

### **Applying Coherence-Building Tools and Heart Rhythm Coherence Feedback Training in Educational Settings**

Programs incorporating HeartMath tools and the Freeze-Framer coherence-building technology have been introduced at the elementary, middle school, high school, college, and graduate levels across the United States and have been demonstrated in studies to improve emotional well-being, classroom behaviors, learning, and academic performance (Arguelles et al., 2003). In one study, conducted in collaboration with the Miami Heart Research Institute, heart rhythm coherence feedback training was used to facilitate learning of the HeartMath tools in at-risk middle school students. Participating students demonstrated a significant reduction in risky behaviors and significant improvements in areas including motivation; work management and focus; stress and anger management; self-reliance; and relationships with teachers, families, and peers. Additionally, when confronted with an acute



**Figure 2.** Getting in sync. A student uses the Freeze-Framer heart rhythm coherence feedback system.

stressor in a laboratory test, the trained students exhibited increased stress resiliency in relation to a control group; real-time heart rate variability data indicated that the students were able to favorably modulate their autonomic response to stress by using the HeartMath techniques (McCraty, Atkinson, Tomasino, Goelitz, & Mayrovitz, 1999).

The HeartMath tools and technologies have also been integrated in a curriculum called TestEdge, which is designed to reduce test anxiety and improve academic and test performance. In this course, students become more aware of how their attitudes and emotions affect their performance; they also learn several positive emotion-based coherence-building techniques and practice applying them in school-related and other contexts. Students have found the heart rhythm coherence feedback component of the course of particular value. They often report that practicing the coherence-building tools with the Freeze-Framer enables them to confirm how it feels to be in sync, in a high-performance state, and thus helps them to learn to enter this state at will in preparation for test-taking or other challenging activities. In pilot studies, high school students who participated in the TestEdge program showed a 14%–35% gain in scores on state-mandated achievement tests as well as significant improvements in numerous measures of emotional health (Arguelles et al., 2003). The program's success in a number of schools subsequently led to a

large-scale national study, funded by the U.S. Department of Education, to evaluate the impact of the program in schools in nine different states. The study, currently underway, will assess the impact of the program on student test anxiety, high-stakes test performance, psychosocial functioning, and classroom behaviors. In addition, a substudy will assess the effects of the tools taught in the program on heart rhythm coherence and performance on a stress-producing cognitive task (simulating a testing situation).

Most recently, the Institute of HeartMath received a grant from the U.S. Department of Education to study the effects of an intervention designed to address the national problems of student dropout and teacher attrition. Our approach to these issues sees them as symptomatic of a larger systemic deficiency facing many schools in the U.S. educational system—namely, *the lack of a healthy social and emotional environment that optimizes the growth and performance of all individuals in the school system*. High student dropout and teacher attrition rates—and low academic performance—are most often produced in schools in which the social and emotional environment is fraught with discordant relations, emotional disaffection, and stress. Our initiative will thus aim to develop, implement, and evaluate a comprehensive multiyear, whole-school system program that aims to build a strong, positive, and nurturing social and emotional environment in the school system. HeartMath programs will be delivered to all teachers, administrators, and other school staff within two whole school systems (each comprised of a high school and the corresponding middle and elementary schools that feed into it). In addition, students at three different grade levels will participate in classroom-based programs in which they will learn the HeartMath tools. The Freeze-Framer coherence-building system will be used to facilitate both student and staff programs, and units will be made available for continued use by all school system members. By providing effective tools for reducing stress; building supportive, collaborative relations; and increasing positive emotional engagement among students, teachers, and school staff, it is expected that the intervention will not only reduce teacher attrition and student dropout, but also lead to improved teaching effectiveness and student academic performance.

## Conclusion

In sum, research suggests that by learning to increase psychophysiological coherence, students can reduce

stress and increase nervous system harmony, thereby improving emotional stability, cognitive functioning, academic performance, and social behaviors. Coherence can be facilitated and noninvasively measured in school settings using positive emotion-focused techniques in conjunction with heart rhythm coherence biofeedback. Such approaches have been associated with improvements in test scores, classroom behaviors, and social-emotional outcomes within a relatively brief time frame in studies conducted among diverse student populations. Collectively, results suggest that the integration of coherence-building tools and heart rhythm coherence biofeedback technologies in educational curricula can be an effective means to facilitate and integrate the emotional, social, and academic development of students while enhancing the climate of the school as a whole. Successful results of these programs in larger-scale implementations will constitute an important finding that has the potential to influence educational practices and improve the quality of education at the national level.

## Acknowledgment

HeartMath is a registered trademark of the Institute of HeartMath; Freeze-Framer is a registered trademark of Quantum Intech, Inc.; and TestEdge is a registered trademark of HeartMath LLC.

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