The Psychophysiological Basis of Creativity and Intuition: Accessing "The Zone" of Entrepreneurship

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Abstract: Successful entrepreneurs are innovators and risk-assessors who have an extraordinary ability to know where future business opportunities will eventuate and how to profitably actualize these ventures. Entrepreneurial decision and action is thus informed by an unusually high degree of both creativity and intuition. Research has identified a distinct psychophysiological state that appears to facilitate creativity and receptivity to intuitive insight. This state, termed *psychophysiological coherence*, is naturally activated during the experience of sustained positive emotions and is characterized by a global shift toward increased order, synchronization, and harmony in an individual's physiological and psychological processes. This article describes the physiological and psychological correlates of coherence and discusses how this state facilitates the processes underlying creativity and intuition. In examining creative and intuitive processes as whole-body phenomena, particular attention is given to the important role played by interactions between the heart and brain. Also described is a research-based system of techniques used to increase psychophysiological coherence and thus to systematically enhance intuitive receptivity and creativity at will. By providing real-time, objective validation of the coherent state, heart rhythm feedback technology facilitates the shift to an optimal psychophysiological "zone" for enhancing creativity and intuition. Coherence-building techniques and technologies have important applications in both entrepreneurial research and practice.

Keywords: intuition; creativity; entrepreneurship; psychophysiology; positive emotions; heart; heart rate variability (HRV); psychophysiological coherence; coherence-building techniques; heart rhythm coherence feedback.

Reference to this paper should be made as follows: Tomasino, D. (2007). "The Psychophysiological Basis of Creativity and Intuition: Accessing "The Zone" of Entrepreneurship", *Int. J. Entrepreneurship and Small Business*, in press.

Biographical notes: Dana Tomasino has served as a researcher and scientific writer at the Institute of HeartMath (Boulder Creek, California) since 1995. With a prior research background in biochemistry and molecular biology, she maintains a passion for using an energy-based approach to elucidate fundamental patterns and processes that connect and unify the cellular/molecular, physiological,

emotional, social, and spiritual dimensions of human experience. At the Institute of HeartMath for the past decade she has been involved in research on the psychophysiology of emotions, with a focus on heart–brain interactions and the mechanisms by which positive emotions influence cognitive processes, behavior, and health. Findings from this research have been applied to the development of heart-based tools and technologies to optimize individual and organizational health, performance, and quality of life. Her current research interests include the psychophysiology of positive emotions and optimal performance; the role of heart–brain interactions in emotion, cognition, and intuition; and energetic interactions within and between people.

1 Introduction

Successful entrepreneurs are passionate innovators and risk-assessors who are distinguished both by their extraordinarily accurate foresight regarding the locus of future business opportunities and their exceptional ability to bring these opportunities to fruition. The patterns of thought and action displayed by entrepreneurs are thus informed by an unusually high degree of both creativity and intuition. However, as yet there is little scientific information to explain the internal processes by which and conditions under which entrepreneurial intuition and creativity occur. Understanding the psychophysiological processes that underlie these capacities is an important step towards learning how creativity and intuition are activated; how these capacities can be consciously developed and enhanced; and, ultimately, how they can be accessed by the individual at will.

For the purposes of this article, creativity is viewed as a process involving the generation of new ideas or concepts and/or novel patterns of behavior. These often emerge from the perception of new patterns of association among existing conceptions. The result is products or outcomes that possess both originality and utility. The creative process is characterized by a high degree of innovation, ingenuity, and divergent thinking; it thus involves both an openness to novelty and a toleration of uncertainty. Creativity is directly related to intuition: creative thought and action often involve inspiration, cognitive "leaps," and intuitive insight. For our purposes, intuition is viewed as a process by which information normally outside the range of cognitive processes is directly sensed and perceived by the body's psychophysiological systems as certainty of knowledge or feeling (positive or negative) about a nonlocal object, entity, or event. Intuitions can encompass information about entities in the material world, as well as abstract constructs such as thoughts and ideas. As a holistic experience, intuition involves immediate apprehension of the totality of a given object, situation, or idea. This is quite unlike the informational processing experience of normal awareness, in which the mind's contents are updated incrementally as the moment-by-moment sequence of sensory experience unfolds. Rather than being based on reason or logic, or on memories or extrapolations from the past, intuitive perception is postulated to involve the body's connection to a nonlocal field of information beyond the spatiotemporal domain of normal conscious awareness (McCraty, Atkinson, & Bradley, 2004a, 2004b; Bradley, 2006).

New research supports the concept that creative and intuitive processes are not confined to the brain alone. Rather they are *whole-body* functions emerging from complex interactions among the body's psychophysiological systems (see McCraty, Atkinson, & Bradley, 2004a, 2004b). Recent research has led to new discoveries about the interaction of the emotional and physiological systems in giving rise to creativity and intuition. To begin, it is necessary to examine the generative role of positive emotions in these processes.

2 Positive Emotions, Creativity, and Intuition

2.1 Emotions, Cognitive Processes, and Behavior

Many of us can recall a time when, while feeling a notable inner sense of contentment, peace, and well-being, we noticed that a stream of creative ideas seemed to flow more freely than usual. In this experience, innovative solutions to challenging problems seemed to emerge effortlessly, and our consciousness felt more keenly attuned to novel intuitions that led us toward promising outcomes. Conversely, we may also remember instances when our conscious awareness was dominated by feelings of anxiety, tension, stress, or depression. In these situations, our attention seemed focused in a rigid and constricted manner and our resourcefulness in problem-solving was limited. In short, any creative or intuitive ability felt blocked, virtually inaccessible.

These typical experiences, shared by many, are corroborated by a growing body of empirical evidence showing that positive and negative emotional states are in fact associated with qualitatively different modes of cognitive information processing, leading to different behavioral results (reviewed in Isen, 1990, 1999; see also Fredrickson, 1998; Derryberry & Tucker, 1994; Fiedler, 1988; Bolte, Goschke, & Kuhl, 2003). Individuals in a positive emotional state, as compared to a negative or neutral state, display patterns of thought and action that are notably creative, flexible, integrative, and open to information. They produce more unusual associations, perform better on tasks requiring innovative problem-solving, prefer heuristic over exhaustive decision-making strategies, and make more accurate intuitive judgments. In short, positive emotions appear to broaden the scope of perception, cognition, and behavior and to enhance creative and intuitive capacities. Conversely, negative emotions tend to restrict perception, produce more reactive, rigid, and stereotypic patterns of thought and action, and have been found to be associated with reduced task performance and impaired intuitive judgments.

Research at the Institute of HeartMath over the past decade has focused on achieving a basic understanding of *how* different emotions exert such effects on cognition and behavior. More specifically, we have sought to identify the physiological correlates of positive emotional states that may help explain their enhancement of intuition, creativity, and performance. In recent years, this research has centered on elucidating emotion-related changes in the patterns of the heart's rhythmic activity and on understanding how the heart's extensive input to the brain affects cognitive function and behavior.

2.2 The Physiology of Positive Emotions

In the early stages of our research examining how psychophysiological patterns change during stress and different emotional states, we sought to determine which physiological variables were most sensitive and responsive to changes in emotion. In analyzing many different physiological measures, we discovered that the rhythmic beating patterns of the heart were consistently the most reflective of changes in emotional states, in that they *covaried with emotions in real time*.

Specifically, we examined the natural fluctuations in heart rate, known as heart rate variability (HRV) or *heart rhythms*, which are a product of the dynamic interplay among many of the body's systems. Short-term (beat-to-beat) changes in heart rate are largely generated and amplified by the interaction between the heart and brain via the flow of neural signals through the efferent and afferent pathways of the sympathetic and parasympathetic branches of the autonomic nervous system (ANS). HRV is thus considered a measure of neurocardiac function that reflects heart–brain interactions and ANS dynamics.

Utilizing HRV analysis, we have demonstrated that distinct heart rhythm patterns characterize different emotional states (McCraty et al., 1995; Tiller, McCraty, & Atkinson, 1996). In general, emotional stress and negative emotions such as anger, frustration, and anxiety lead to heart rhythm patterns that appear *incoherent*—irregular and erratic (Figure 1). Overall, compared to a neutral baseline state, this indicates less synchronization in the reciprocal action of the parasympathetic and sympathetic branches of the ANS. This desynchronization in the ANS, if sustained, taxes the nervous system and bodily organs, impeding the efficient synchronization and flow of information throughout the psychophysiological systems.

In contrast, sustained positive emotions, such as appreciation, care, compassion, and love, generate a smooth, sine-wave-like pattern in the heart's rhythms. Relative to a neutral baseline, this pattern reflects increased synchronization between the two branches of the ANS and a general shift in autonomic balance towards increased parasympathetic activity. As is visually evident (Figure 1) and also demonstrable by quantitative methods (McCraty et al., 2006; Tiller, McCraty, & Atkinson, 1996), heart rhythms associated with positive emotions such as appreciation are clearly more *coherent*—organized as a stable pattern of smooth, cyclic waves—than those generated during a negative emotional experience such as frustration.

We observed that these associations were found in studies conducted in both laboratory and natural settings, and for both spontaneous emotions and intentionally generated feelings. An important point to emphasize is that although heart *rate* or the *amount* of HRV can also covary with emotional changes, our findings showed that it is the larger-scale *pattern* of the heart's rhythmic activity that is most directly related to emotional dynamics (McCraty et al., 2006).

Taking this research further, we also observed that when positive emotional states are intentionally maintained, coherent heart rhythm patterns can be sustained for longer periods, which, in turn, leads to increased synchronization and entrainment between the heart's rhythm and the activity of multiple bodily systems. Based on the distinctive set of physiological and psychological correlates that are consistently observed in such states across diverse subject populations, we have introduced the term *psychophysiological coherence* to describe this particular mode of functioning (McCraty et al., 2006).

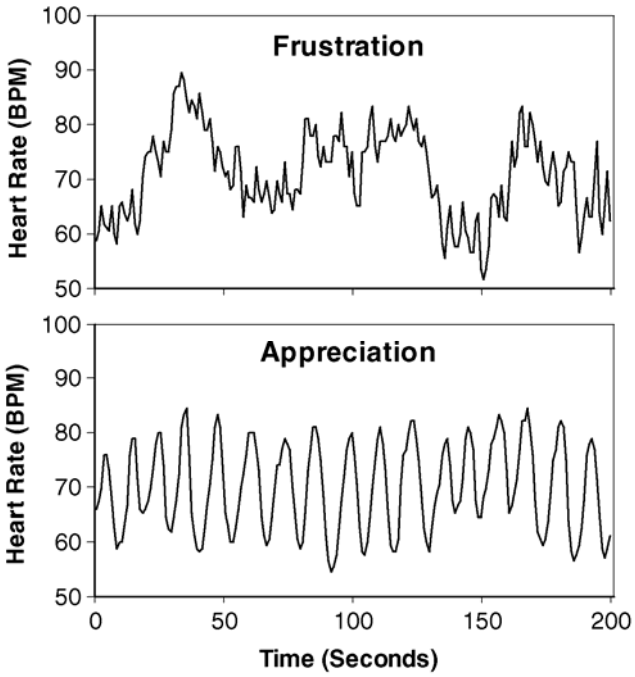

Figure 1. Heart rhythm patterns during different emotional states. These graphs show examples of real-time heart rate variability patterns (heart rhythms) recorded from individuals during self-induced states of frustration and appreciation. The *incoherent* heart rhythm pattern shown in the top graph, characterized by its irregular, jagged waveform, is typical of negative emotions such as anger, frustration, and anxiety. The bottom graph shows an example of the *coherent* heart rhythm pattern that is typically observed when an individual is experiencing a sustained positive emotion, such as appreciation, compassion, or love. The coherent pattern is characterized by its regular, sine-wave-like waveform.

3 Psychophysiological Coherence: A State of Optimal Function

In essence, the psychophysiological coherence mode is a highly efficient state characterized by a global shift toward increased order, synchronization, and harmony in an individual's physiological and psychological processes. At the physiological level, this mode manifests as more ordered activity and synchronous interactions among the body's systems, encompassing biophysical phenomena such as autocoherence, entrainment, synchronization, and resonance (McCraty et al., 2006; McCraty & Childre, 2004). As described above, this mode is associated with increased coherence in the heart's rhythmic activity (*autocoherence*), which manifests as a sine-wave-like heart rhythm pattern oscillating at a frequency of approximately 0.1 hertz. Thus, in this mode the HRV power spectrum is dominated by an unusually high-amplitude peak near the center of the low frequency range.

Furthermore, during the psychophysiological coherence mode, there is increased *cross-coherence* or *entrainment* among the rhythmic patterns of activity generated by different physiological oscillatory systems. Because the heart is the body's most powerful rhythmic oscillator and generates the strongest rhythmic wave pattern, as the heart's rhythm becomes more coherent it drives other oscillatory systems into entrainment with it so that all come to oscillate at the same frequency. Typically, entrainment is observed between heart rhythms, respiratory rhythms, and blood pressure oscillations; however, other biological oscillators, including very low frequency brain rhythms, craniosacral rhythms, and electrical potentials measured across the skin, can also become entrained (McCraty et al., 2006; Tiller, McCraty, & Atkinson, 1996).

Finally, psychophysiological coherence is characterized by increased synchronization between the activity of the heart and brain. Specifically, we have found that the brain's alpha rhythms exhibit increased synchronization with the cardiac cycle during this mode (McCraty et al., 2006; McCraty & Childre, 2004).

In terms of physiological functioning, the coherence mode confers a number of benefits to the system. These include: (i) resetting of baroreceptor sensitivity, which is related to improved short-term blood pressure control and increased respiratory efficiency; (ii) increased vagal afferent traffic, which is involved in the inhibition of pain signals and sympathetic outflow; (iii) increased cardiac output in conjunction with increased efficiency in fluid exchange, filtration, and absorption between the capillaries and tissues; (iv) increased ability of the cardiovascular system to adapt to circulatory requirements; and (v) increased temporal synchronization of cells throughout the body. This results in increased system-wide energy efficiency and conservation of metabolic energy (McCraty et al., 2006). These observations support a link between positive emotions and increased physiological efficiency, which may partially explain the growing number of documented correlations between positive emotions, improved health, and increased longevity (e.g., Danner, Snowdon, & Friesen, 2001; Russek & Schwartz, 1997). We have also shown that practicing techniques that increase psychohysiological coherence is associated with both short-term and long-term improvement in several objective health-related measures, including enhanced humoral immunity (McCraty et al., 1996; Rein, Atkinson, & McCraty, 1995) and an increased DHEA/cortisol ratio (McCraty et al., 1998).

Psychophysiological coherence is similarly associated with beneficial psychological correlates, including reduced perception of stress, sustained positive affect, and a high degree of mental clarity and emotional stability. In contrast to dissociative states such as relaxation, the coherence mode promotes a calm, balanced, yet alert and responsive psychological state that is conducive to everyday functioning, including problem-solving, decision-making, and the performance of tasks requiring mental acuity, focus, and creativity (McCraty et al., 2006; McCraty & Tomasino, 2006). Controlled studies have shown that maintaining a state of psychophysiological coherence is associated with significant improvements in cognitive performance, including both long-term and short-term memory, as well as reaction time on a task requiring focused attention and accurate discrimination (McCraty et al., 2006).

Executives and business professionals trained to activate and sustain coherence frequently report marked changes in their psychological state, work effectiveness, and in the way they process information. Typical experiences (from the reports of thousands of individuals trained in coherence-building methods) include a notable reduction in extraneous internal mental dialogue, an increased sense of emotional balance and clarity,

more effective decision-making, improved work flow, enhanced creativity, and increased intuitive discernment (Childre & Cryer, 2000).

4 Coherence and Heart–Brain Communication

To understand how the generation of psychophysiological coherence leads to these outcomes, it is necessary to look deeper at the multifaceted role of the heart in the human system and to understand how brain function is continuously influenced by a flow of information from the heart. Recent research has established that the heart functions as far more than simply a pump in the human body. Research in the field of neurocardiology has revealed that the heart is in actuality a complex information encoding and processing center, possessing an intrinsic nervous system sufficiently sophisticated to qualify as *"little brain"* in its own right. Its circuitry enables it to learn, remember, and make functional decisions independent of the cranial brain (Armour & Kember, 2004).

The heart also functions as a sensory organ, and is particularly sensitive and responsive to changes in a number of other psychophysiological systems. For example, heart rhythm patterns are continually modulated by changes in the activity of either branch of the ANS, and the heart's extensive intrinsic network of sensory neurons also enables it to detect and respond to variations in hormonal rhythms and patterns (Armour & Kember, 2004). In addition, the heart is itself an endocrine gland that manufactures and secretes multiple hormones and neurotransmitters (McCraty et al., 2006).

Furthermore, the heart possesses a much more extensive communication system with the brain than do any of the body's other major organs. Through this system of afferent (ascending) neural pathways, the heart actually sends more information to the brain than the brain sends to the heart (Cameron, 2002). An extensive body of research has shown, moreover, that cardiac afferent input not only exerts homeostatic effects via cardiovascular regulatory centers in the brain, but also influences the activity and function of higher brain centers involved in perceptual, cognitive, and emotional processing (reviewed in McCraty et al., 2006). Both neurophysiological and behavioral data indicate that afferent input from the heart and cardiovascular system influences the processing of sensory information. For instance, studies have documented that cardiac-related afferent input modulates a wide range of processes, including visual perception (Walker & Sandman, 1982), reaction times (Lacey & Lacey, 1974), pain perception (Randich & Gebhart, 1992), electrocortical activity (Rau et al., 1993), and cognitive functions (Sandman, Walker, & Berka, 1982; van der Molen, Somsen, & Orlebeke, 1985).

Our own data support and extend this body of research by indicating that the *pattern* of the heart's rhythmic activity—and thus the corresponding pattern of cardiac afferent neural signals transmitted to the brain—can play an important role in inhibiting or facilitating higher cognitive functions (McCraty et al., 2005). Our research suggests that during emotional stress, when the heart's rhythm is erratic or *incoherent*, this discordance communicates a signal to the brain that results in the inhibition of higher brain processes involved in perception, attention, reasoning, and creativity. This can help explain why we often cannot think clearly, make careless mistakes, and have little access to our creative capacities when under stress. This "cortical inhibition" also may help account for other research findings indicating that negative emotional states tend to produce more rigid and limited patterns of thought and action (e.g., Fredrickson &

Branigan, 2005), and also reduce the ability to make accurate intuitive judgments (Bolte, Goschke, & Kuhl, 2003).

In contrast, during positive emotional states, when the heart generates a harmonious, coherent pattern of activity, the resulting pattern of cardiac afferent input to the brain contributes to "cortical facilitation," whereby higher cognitive faculties are enhanced. This interaction between the heart and brain may provide a physiological basis for the growing body of evidence demonstrating a link between positive emotions and improved creativity, cognitive flexibility, innovative problem-solving, "flow," and intuition (e.g., Isen, 1998, 1999; Csikszentmihalyi, 1990; Bolte, Goschke, & Kuhl, 2003)—faculties that are also frequently enhanced during or following the generation of the psychophysiological coherence mode. We postulate, therefore, that the activation of positive emotions and the coherence mode leads to state in which higher cognitive faculties are facilitated (McCraty et al., 2006).

4.1 Heart Signals, Coherence, and Intuition

Another important link is provided by electrophysiological data from a recent study, which showed that the neurological signals sent from the heart to the brain are involved in the processing of intuitive information (McCraty, Atkinson, & Bradley, 2004a, 2004b). Using a rigorous experimental design, this study found objective electrophysiological evidence that both the heart and the brain receive and respond to information about a future event 3 to 5 seconds *before the event actually happens*. Even more surprising was our finding that the heart appears to receive this intuitive information approximately 1.5 seconds *before* the brain. Results of event-related potential and heartbeat evoked potential analyses suggest that the heart's afferent input to the brain may contain information pertaining to the future stimulus, thereby informing intuitive perception. Our data further indicated that during a state of psychophysiological coherence, the processing of pre-stimulus information in the brain is modified by the heart's afferent signals (McCraty, Atkinson, & Bradley, 2004b). These data point to a clear role for the heart in the psychophysiological processing of intuitive information and suggest that such processing is enhanced by maintaining the coherent state.

The state of psychophysiological coherence is marked by a number of notable internal changes. There is a quieting of the extraneous inner "noise" generated by the normal stream of thoughts and emotions, in conjunction with a positive emotion-driven global shift toward increased synchronization and harmony in psychophysiological processes. These changes not only enhance cognitive functioning, but also appear to result in increased receptivity and sensitivity to information that is normally outside the range of conscious awareness. In developing a theory of how this occurs, Bradley (2006) postulates that the coherent structure of the electromagnetic field generated by the heart during this state, through an oscillatory resonance mechanism, enables the creation of an optimal communication channel between the wave fields generated by the body and those generated by other objects and entities. It is speculated that this provides a mechanism by which nonlocal information can be transmitted at hyper-speeds, by a quantum-holographic process, across macro and micro-scales of organization, thus enabling us to have accurate foreknowledge of objects distant in space or events ahead in time. (For a detailed account of this theory, see Bradley, 2006.)

5 Coherence-Building Tools and Technologies

Based on an extensive body of scientific research, the Institute of HeartMath has developed a system of easy-to-use positive emotion-focused techniques that enable individuals to reliably self-generate and sustain psychophysiological coherence and its associated benefits (Childre & Martin, 1999; Childre & Rozman, 2005). Collectively known as the HeartMath system, these coherence-building techniques combine a shift in the focus of attention to the area around the heart (where many people subjectively experience positive emotions) with the self-induction of a sincere positive emotional state, such as appreciation. Such an intentional shift in focus and feeling significantly reduces the constant chatter of mental, emotional, and physiological activity associated with the stresses of daily life and facilitates the natural emergence of the psychophysiological coherence mode. With practice, the techniques also enable this state to be sustained for extended periods. Studies have shown that the practice of these techniques significantly reduces stress and negative affect (McCraty et al., 1998; McCraty, Atkinson, & Tomasino, 2003), improves nervous system function and hormonal balance (McCraty et al., 1998; Tiller, McCraty, & Atkinson, 1996), lowers blood pressure and other physiological and psychological health risk factors (McCraty et al., 2003; McCraty, Atkinson, & Tomasino, 2003), improves cognitive and task performance (McCraty et al., 2006) and leads to significant improvements in many aspects of psychosocial functioning across diverse populations (for a summary of outcome studies, see McCraty, Atkinson, & Tomasino, 2001; McCraty & Childre, 2004). Because these techniques are designed to be easily used in the course of daily life, they provide the individual with a practical means to systematically access an internal state that enhances the flow of creative and intuitive processes.

The learning and effective use of coherence-building tools can be greatly facilitated by *heart rhythm coherence feedback training.* This technology provides real-time physiological feedback that serves as a powerful aid and objective validation in the process of learning to self-generate increased psychophysiological coherence (McCraty & Tomasino, 2004). A heart rhythm coherence feedback system called the Freeze-Framer (Quantum Intech, Boulder Creek, California; Figure 2) incorporates a technology that enables heart rhythm coherence, the key physiological marker of the psychophysiological coherence mode, to be objectively monitored and quantified in real time. Using a noninvasive fingertip or earlobe plethysmographic sensor to record the pulse wave, this interactive hardware/software system plots changes in heart rate on a beat-to-beat basis. As users practice coherence-building techniques, they can readily see and experience the changes in their heart rhythm patterns, which become more ordered, smoother, and more sine-wave-like as they shift to the coherent state (see Figure 3). The software also analyzes the heart rhythm patterns for coherence level, which is fed back to the user as an accumulated score. In addition to a real-time display of the user's heart rhythm patterns, the system incorporates a tutorial providing instruction in the HeartMath coherence-building techniques, a multi-user database to track progress, and three interactive heart rhythm training modules whose output is controlled by the level of coherence achieved. Because the Freeze-Framer technology uses a pulse wave sensor and involves no electrode hook-up, it is portable, time-efficient, and easy to use in a wide variety of settings. This heart rhythm coherence feedback technology is available on two platforms: a personal computer-based version (shown in Figure 2) and a newly developed handheld version.[1]

Figure 2. The Freeze-Framer heart rhythm coherence feedback trainer.

By providing objective validation of the coherent state, heart rhythm coherence feedback training enables individuals to quickly become familiar with the feeling experience associated with a shift to an optimal psychophysiological state for enhancing creativity and intuition. Effectively, just as athletes train to enter their "zone" of optimal performance, individuals can learn to access an optimal psychophysiological "zone" for facilitating creative and intuitive flow. The power of this approach lies in the fact that as people consistently use the system to facilitate a shift to coherence, the synchronized, harmonious patterns of psychophysiological activity associated with the coherent mode become increasingly familiar to the brain and body as they are reinforced in the neural architecture. In this way, through a feed-forward process, these coherent patterns become established as a new baseline or set point, which the system then automatically strives to maintain. This *repatterning process* results in the coherent state becoming more easily accessible, even during stress or challenge, and can also lead to increased spontaneous occurrences of coherence as this state progressively becomes a more "automatic" way of being. Evidence from research studies suggests that such a system-wide repatterning process accounts for the sustained improvements in health, emotional well-being, and performance that have been documented across diverse populations with practice of HeartMath techniques (McCraty & Tomasino, 2006). This process can also help explain the development of increased intuitive awareness reported by many practitioners of these tools.

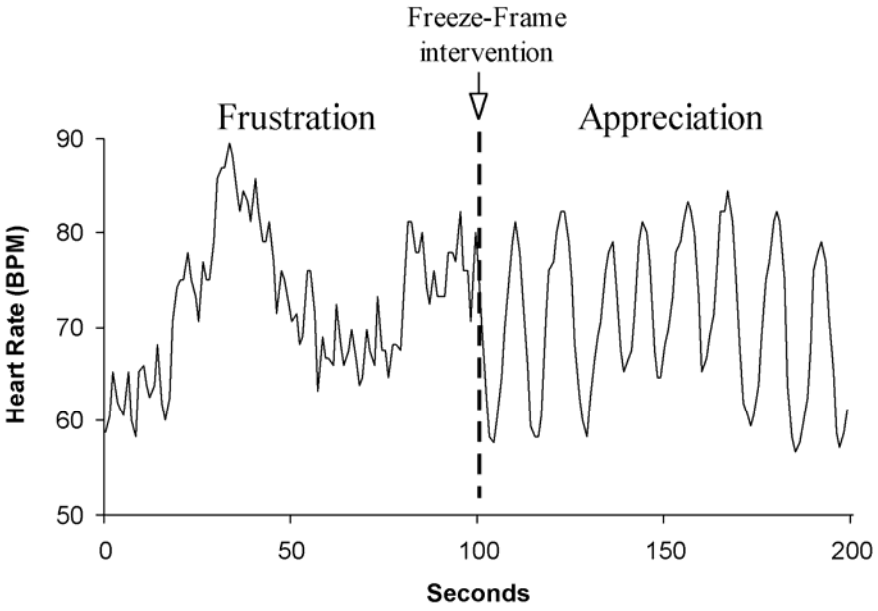

Figure 3. Shift to coherence. Real-time heart rhythm pattern of an individual making an intentional shift from a feeling of frustration to one of appreciation by using HeartMath's "Freeze-Frame" positive emotion refocusing technique (at the dotted line).

5.1 Applications of Coherence-Building Tools in Entrepreneurship

The HeartMath techniques and Freeze-Framer technology are currently used worldwide by multinational corporations, government organizations, the military, Olympic and professional athletes, health care organizations, individual health care practitioners, and educational institutions. These tools also have potential important applications in entrepreneurial research and practice. For example, the Freeze-Framer system could be readily utilized as a measurement device in research on entrepreneurial intuition, to help further elucidate the specific psychophysiological correlates of intuitive perception, as is planned in a future study to be conducted by La Pira and Gillin (2006).

This system also holds promise as a powerful tool for training existing and prospective entrepreneurs to enhance their creative and intuitive abilities. Using coherence-building methods, entrepreneurs may be able to hone and further develop their natural capacities for creative ingenuity and intuitive insight by effectively establishing an internal psychophysiological milieu that is conducive to these processes. Rather than relying solely on spontaneous, unpredictable, episodic occurrences of creativity and intuition, entrepreneurs can thereby learn how to *consciously and systematically* access these faculties when most needed to guide critical business decisions.

6 Conclusion

In the fast-moving, highly complex global economy of the Twenty-First Century, it takes an individual with extraordinary intuitive foresight to know where latent opportunities are emerging for new business ventures that hold great future promise. Such intuitive ability also guides the serial entrepreneur at each decision point through the *whole* process of actualizing this business potential into a successful economic reality.

In this article we have seen how an increased scientific understanding of the psychophysiological basis of intuition has enabled the development of practical techniques and technologies to help people learn how to systematically enhance intuitive receptivity at will. The basis of these tools and technologies is the intentional adoption of a positive emotional focus to generate the state of psychophysiological coherence. The state of coherence facilitates the body's global shift to increased order, synchronization, and harmony in an individual's physiological and psychological processes. This, in turn, is associated with the stilling of the extraneous inner "noise" generated by one's normal mental and emotional processes, and the facilitation of higher cognitive and sensory capacities, including creativity and intuition. It is postulated that the coherent structure of the energetic field generated by the heart during this state enables the creation of an optimal communication channel between the energetic wave fields generated by the body and those generated by other objects and entities. This provides the means through which nonlocal information is communicated by a quantum-holographic process, enabling accurate foreknowledge of objects or events distant in space or ahead in time.

The learning and practice of coherence-building techniques can be greatly facilitated by heart rhythm coherence feedback technology, which enables psychophysiological coherence to be objectively monitored and quantified in real time. By providing objective validation of the coherent state, this technology enables individuals to quickly become familiar with the feeling experience associated with a shift to an optimal psychophysiological *zone* for enhancing creativity and intuition. Coherence-building tools and heart rhythm coherence feedback technology have significant applications in entrepreneurial research and practice, including use as a measurement tool, as well as in training existing and prospective entrepreneurs to enhance their creative and intuitive capacities.

The scientific elucidation of a specific psychophysiological state associated with enhanced intuition and creativity offers objective data that may well help to demystify the extraordinary intuitive and creative ability demonstrated by serial entrepreneurs. Moreover, of even greater practical benefit to the entrepreneur is the availability of a *systematic process* whereby individuals can regularly self-activate this state of optimal function. Thus, rather than relying solely on spontaneous, episodic occurrences of creativity and intuition, entrepreneurs can learn how to *intentionally* access these faculties when most needed to inform their decisions and shape their actions. Building such psychophysiological capacity not only makes these abilities more accessible in the moment, but also, through practice, naturally generates an enhanced intuitive and creative flow as a result of establishing a new psychophysiological baseline.

By way of concluding, systematic use of entrepreneurial intuition has a number of broader implications. As more entrepreneurs hone their intuitive abilities and achieve greater business success, the opportunity cost of unrealized business potential will be reduced. This constitutes an economic benefit for all. Also, improved entrepreneurial intuition will help increase the success rate of new business activity and, correspondingly,

likely reduce business failures and losses. This will contribute to increased efficiency and effectiveness in the use of scarce economic resources. Finally, the psychophysiological approach to understanding entrepreneurship presented here and elsewhere (Bradley, 2006; La Pira and Gillin, 2006) opens up a new domain of knowledge and research on the theory of business decision-making. At the very least, this new approach suggests the need to complement the mind-based "rational" models of economic decision-making with a *whole-body* model that also incorporates intuitive perception of nonlocal information. By accessing "the zone" of entrepreneurial intuition, in which information from a domain beyond the bounds of space and time is perceived and processed by the body's psychophysiological systems, it would appear that serial entrepreneurs transcend the constraints of Simon's bounded rationality.

Note

[1] For additional information on the Freeze-Framer® technology, see: www.heartmath.com/freezeframer. Newly updated versions of this technology, in both personal computer-based and handheld formats, will be released in 2006 under the name emWave™.

Acknowledgments

I am grateful to Dr. Raymond Bradley for his support and helpful comments on an earlier draft of this manuscript.

References

Armour, J. A., & Kember, G. C. (2004). "Cardiac sensory neurons." In J. A. Armour & J. L. Ardell (Eds.), *Basic and Clinical Neurocardiology* (pp. 79-117). New York: Oxford University Press.

Bolte, A., Goschke, T., & Kuhl, J. (2003). "Emotion and intuition: Effects of positive and negative mood on implicit judgments of semantic coherence." *Psychological Science, 14*(5), 416-421.

Bradley, R. T. (2006). "The psychophysiology of entrepreneurial intuition: A quantum-holographic theory." In *Proceedings of the Third AGSE International Entrepreneurship Research Exchange*, February 8–10, Auckland, New Zealand.

Cameron, O. G. (2002). *Visceral Sensory Neuroscience: Interoception.* New York: Oxford University Press.

Childre, D., & Cryer, B. (2000). *From Chaos to Coherence: The Power to Change Performance*. Boulder Creek, CA: Planetary.

Childre, D., & Martin, H. (1999). *The HeartMath Solution*. San Francisco: HarperSanFrancisco.

Childre, D., & Rozman, D. (2005). *Transforming Stress: The HeartMath Solution to Relieving Worry, Fatigue, and Tension*. Oakland, CA: New Harbinger Publications.

Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper & Row.

Danner, D. D., Snowdon, D. A., & Friesen, W. V. (2001). "Positive emotions in early life and longevity: findings from the nun study." *Journal of Personality and Social Psychology, 80*(5), 804-813.

Derryberry D., & Tucker, D. M. (1994). Motivating the focus of attention. In P. M. Niedenthal & S. Kitayama (Eds.) *The Heart's Eye: Emotional Influences in Perception and Attention* (pp. 167-196). San Diego: Academic Press.

Fiedler, K. (1988). "Emotional mood, cognitive style, and behavior regulation." In K. Fiedler & J. P. Forgas (Eds.) *Affect, Cognition and Social Behavior* (pp. 100-119). Toronto: Hogrefe International.

Fredrickson, B. L. (1998). "What good are positive emotions?" *Review of General Psychology, 2*(3), 300-319.

Fredrickson, B. L., & Branigan, C. (2005). "Positive emotions broaden the scope of attention and thought-action repertoires." *Cognition and Emotion, 19*(3), 313-332.

Isen, A. M. (1990). The influence of positive and negative affect on cognitive organization: Some implications for development. In N. L. Stein, B. Leventhal, & J. Trabasso (Eds.), *Psychological and Biological Approaches to Emotion* (pp. 75-94). Hillsdale, NJ: Lawrence Erlbaum Associates.

Isen, A. M. (1998). "On the relationship between affect and creative problem solving." In S. W. Russ (Ed.), *Affect, Creative Experience, and Psychological Adjustment* (pp. 3-17). Philadelphia: Brunner/Mazel.

Isen, A. M. (1999). "Positive affect." In T. Dalgleish & M. Power (Eds.), *Handbook of Cognition and Emotion* (pp. 522-539). New York: John Wiley & Sons.

Lacey, B. C., & Lacey, J. I. (1974). "Studies of heart rate and other bodily processes in sensorimotor behavior." In P. A. Obrist, A. H. Black, J. Brener & L. V. DiCara (Eds.), *Cardiovascular Psychophysiology: Current Issues in Response Mechanisms, Biofeedback, and Methodology.* (pp. 538-564). Chicago: Aldine.

La Pira, F., & Gillin, M. (2006). "Non-local intuition and the performance of serial entrepreneurs." *International Journal of Entrepreneurship and Small Business, 3*(1), 17-35.

McCraty, R., Atkinson, M., & Bradley, R. T. (2004a). "Electrophysiological evidence of intuition: Part 1. The surprising role of the heart." *Journal of Alternative and Complementary Medicine, 10*(1), 133-143.

McCraty, R., Atkinson, M., & Bradley, R. T. (2004b). "Electrophysiological evidence of intuition: Part 2. A system-wide process?" *Journal of Alternative and Complementary Medicine, 10*(2), 325-336.

McCraty, R., Atkinson, M., Lipsenthal, L., & Arguelles, L. (2003). "Impact of the Power to Change Performance program on stress and health risks in correctional officers." Boulder Creek, CA: HeartMath Research Center, Institute of HeartMath, Report No. 03-014, November.

McCraty, R., Atkinson, M., Rein, G., & Watkins, A. D. (1996). "Music enhances the effect of positive emotional states on salivary IgA." *Stress Medicine, 12*(3), 167-175.

McCraty, R., Atkinson, M., Tiller, W. A., Rein, G., & Watkins, A. D. (1995). "The effects of emotions on short-term power spectrum analysis of heart rate variability." *American Journal of Cardiology, 76*(14), 1089-1093.

McCraty, R., Atkinson, M., & Tomasino, D. (2001). *Science of the Heart: Exploring the Role of the Heart in Human Performance*. Boulder Creek, CA: HeartMath Research Center; Institute of HeartMath, Publication No. 01-001.

McCraty, R., Atkinson, M., & Tomasino, D. (2003). "Impact of a workplace stress reduction program on blood pressure and emotional health in hypertensive employees." *Journal of Alternative and Complementary Medicine, 9*(3), 355-369.

McCraty, R., Atkinson, M., Tomasino, D., & Bradley, R. T. (2006). *The Coherent Heart: Heart–Brain Interactions, Psychophysiological Coherence, and the Emergence of System-Wide Order*. Boulder Creek, CA: HeartMath Research Center, Institute of HeartMath.

McCraty, R., Barrios-Choplin, B., Rozman, D., Atkinson, M., & Watkins, A. D. (1998). "The impact of a new emotional self-management program on stress, emotions, heart rate variability, DHEA and cortisol." *Integrative Physiological and Behavioral Science, 33*(2), 151-170.

McCraty, R., & Childre, D. (2004). "The grateful heart: The psychophysiology of appreciation." In R. A. Emmons & M. E. McCullough (Eds.), *The Psychology of Gratitude* (pp. 230-255). New York: Oxford University Press.

McCraty, R., & Tomasino, D. (2004). "Heart rhythm coherence feedback: A new tool for stress reduction, rehabilitation, and performance enhancement." In *Proceedings of the First Baltic Forum on Neuronal Regulation and Biofeedback*, November 2–4, Riga, Latvia. (Also available at http://www.heartmath.org/research/research-papers/HRV_Biofeedback2.pdf).

McCraty, R., & Tomasino, D. (2006). "Emotional stress, positive emotions, and psychophysiological coherence." In B. B. Arnetz & R. Ekman (Eds.), *Stress in Health and Disease* (pp. 360-383). Weinheim, Germany: Wiley-VCH.

Randich, A., & Gebhart, G. F. (1992). "Vagal afferent modulation of nociception." *Brain Research Reviews, 17*, 77-99.

Rau, H., Pauli, P., Brody, S., & Elbert, T. (1993). "Baroreceptor stimulation alters cortical activity." *Psychophysiology, 30*, 322-325.

Rein, G., Atkinson, M., & McCraty, R. (1995). "The physiological and psychological effects of compassion and anger." *Journal of Advancement in Medicine, 8*(2), 87-105.

Russek, L. G., & Schwartz, G. E. (1997). "Feelings of parental caring predict health status in midlife: a 35-year follow-up of the Harvard Mastery of Stress Study." *Journal of Behavioral Medicine, 20*(1), 1-13.

Sandman, C. A., Walker, B. B., & Berka, C. (1982). "Influence of afferent cardiovascular feedback on behavior and the cortical evoked potential." In J. T. Cacioppo & R. E. Petty (Eds.), *Perspectives in Cardiovascular Psychophysiology* (pp. 189-222). New York: The Guilford Press.

Tiller, W. A., McCraty, R., & Atkinson, M. (1996). "Cardiac coherence: a new, noninvasive measure of autonomic nervous system order." *Alternative Therapies in Health and Medicine, 2*(1), 52-65.

van der Molen, M. W., Somsen, R. J. M., & Orlebeke, J. F. (1985). "The rhythm of the heart beat in information processing." In P. K. Ackles, J. R. Jennings & M. G. H. Coles (Eds.), *Advances in Psychophysiology, vol. 1* (pp. 1-88). London: JAI Press.

Walker, B., & Sandman, C. (1982). "Visual evoked potentials change as heart rate and carotid pressure change." *Psychophysiology, 19*(5), 520-527.