Experimental

NEW ELECTROPHYSIOLOGICAL CORRELATES ASSOCIATED WITH INTENTIONAL HEART FOCUS

Rollin McCraty, M.A., Mike Atkinson & William A. Tiller, Ph.D.

ABSTRACT

This work utilizes the measurement of heart rate variability (HRV) as a vehicle to show that continued practice of certain specific techniques involving an intentional shift of focus to the area of the heart, and invoking specific feeling states such as "love" and "appreciation," automatically manifests in increased autonomic nervous system balance. In particular, (1) enhanced balance between the parasympathetic and sympathetic nervous system, (2) a shift of the high frequency and low frequency portions of the HRV power spectra to around 0.1Hz range, (3) entrainment and frequency locking of multiple body oscillators (HRV, pulse transit time and respiration), (4) a shift in frequency of all the body's entrained systems, around 0.1Hz frequency, associated with a change in focus of the subject to a different heart feeling state, and (5) the intentional generation of a newly defined internal coherence state (near zero HRV), have all been achieved. These are electrophysiological correlates of certain mental and emotional states occupied by the individual. Three individual subjects plus a group study of twenty subjects are reported on and discussed. From these results, one sees that individuals can intentionally affect their autonomic nervous system balance, and thus, their HRV.

KEYWORDS: Electrocardiogram, heart rate variability, mental and emotional states, power spectra, entrainment, stress, consciousness, biological oscillators, electrophysiology, coherence

INTRODUCTION

It is well known that the heart is autorhythmic; *i.e.*, that the source of the heartbeat is within the heart itself rather than coming from some other portion of the body.[1] The heart appears to be a self-controlled organ although its beat or rhythm can be modulated by other segments of the body. Thus, the heart can be considered as a dynamic, non-linear, harmonic oscillator.

Both sympathetic and parasympathetic nerve links connect the brain to the heart allowing signal communication from the brain to the heart. Reverse direction signals also flow along the nerves of the baroreceptor system to the brain completing a two-way communication system between the heart and the brain. Important connections between heart responses and behavior have been proposed and extensively studied by the Laceys.[2-5] Of course, the reverse direction signals from the baroreceptor system are well known to profoundly influence brain function by inhibiting the activity of the brain's cortex, usually regarded as the seat of higher brain function including perception and learning.[2,6-8] Activation of the sympathetic nervous system causes heart rate to increase while the parasympathetic system causes the overall heart rate to decrease.[9] The degree of change depends on the activity of the nerve channel. It is the interaction between these two systems that results in the mean heart rate while the parasympathetic system is the primary source of the beat-to-beat variation in heart rate found in healthy individuals' ECG measurements. This is called heart rate variability (HRV).[10] Thus, although the heart has its own basic rhythm, this rhythm is modified by the autonomic nervous system (ANS) which is, in turn, modified by how we mentally or emotionally perceive events in the moment. Changes in an individual's mental and emotional states therefore manifest as changes in their overall heart rate and HRV power spectra.

Numerous review papers on HRV have appeared in the medical literature.[11-13] They have concluded that HRV power spectrum analysis is a useful non-invasive test of integrated neurocardiac function,[12] which has an important application to the surveillance of post infarction, and that loss of HRV is an indicator of increased incidence of sudden death.[14,15] HRV has also been studied in patients with major depression and panic disorder.[16] Power spectral analysis of HRV after biofeedback training[17] and hypnosis[18] has shown an increase in the high frequency components of the power spectra suggesting an increase of parasympathetic activity. Although it is not yet fully standardized, some members of the medical community have divided the active HRV spectrum into four frequency ranges, VLF (0 to 0.02 Hz), LF (0.02 to 0.05 Hz), MF (0.05 to 0.15 Hz) and HF (0.15 to 0.5 Hz) as largely characterizing (1) thermoregulation, (2) mainly sympathetic with some influences from the parasympathetic, (3) baroreceptor system frequency with a peak at about 0.1Hz, (4) purely parasympathetic, respectively.[11] Other groups divide the spectrum into only two ranges, the LF and HF and use the ratio between them as a marker of sympatho-vagal balance.[11,12] In this paper, we largely follow this latter procedure; however, it is important that the reader realize the importance of the mid-frequency range relating to the baroreceptor activity.

The purpose of the present paper is to extend the use of HRV analysis to the study of how one's mental and emotional states interact with the autonomic nervous system in humans. In particular, we intend to show that the practice of certain specific internal self-management techniques leads to an increasingly balanced mental and emotional nature that, in turn, manifests a set of uniquely defined physiological states as seen via analysis of HRV data. To illustrate, consider the qualitative difference between the three real-time heart rhythm pattern signals for an individual feeling *frustration* versus *appreciation* versus a deeper internal state of inner self management where one can reduce the HRV to near zero (which we have defined as the *internal coherence state*) as shown in Figure 1a. An explanation of terms is included under References and Notes.[19] *Frustration* and *appreciation* are words that characterize the mental and emotional state of the individual, while the graphs are the HRV or electrocardiogram (ECG) electrophysiological correlates that correspond with these states. Spectrum analysis of these heart rhythm pattern signals (HRV) provides frequency domain information that allows us to discriminate both the magnitude and type of sympathetic versus parasympathetic system signals.[12] This is illustrated in Figure 1b indicating the ability to measure the degree of signal balance between the two branches of the autonomic nervous system.[12] An even more significant event occurs when the two nervous systems are "in sync" or integrated. Such an entrainment effect represents optimum coupling efficiency between the two branches and is illustrated by the middle panel in Figure 1b. Whenever one sees such a narrow band signal in the power spectrum of the HRV, or a relatively harmonic signal (sinewave-like) in the time domain representation of the HRV data, we (in agreement with others)[17,20] define this

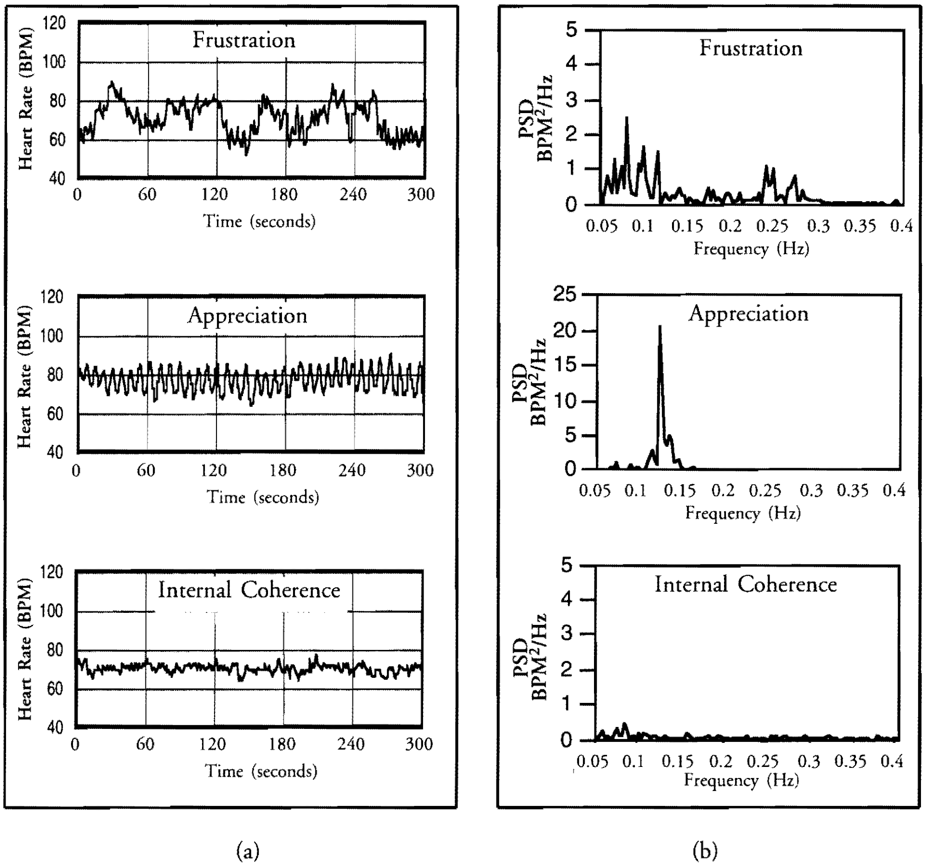
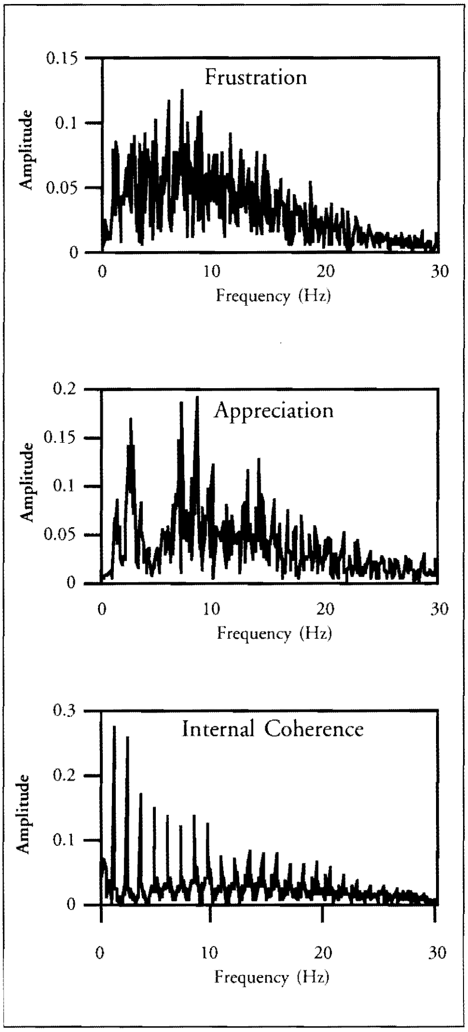


Figure 1a and 1b. *Different modes of heart rate/ECG data presentation for three different mental/emotional states,* ***frustration*** *(top),* ***appreciation*** *(middle) and* ***internal coherence*** *(bottom): a) real-time representation of heart rate for these three states, b) simultaneous HRV power spectra in the frequency domain.*

as *entrainment.* Further, whenever one sees an *intentionally* produced very low amplitude signal in the power spectrum, we define this as *internal coherence.* Most real time HRV data is in the incoherent category, *e.g. frustration.* In Figure 1c, ECG power spectral data is provided for the three real-time conditions represented in Figure 1a. One of our main purposes for introducing Figure 1 is to show three uniquely different ways to represent the basic data. In certain circumstances, one modality of information display will be more powerful than the others.



(c)

Figure 1c. *Different modes of heart rate/ECG data presentation for three different mental/emotional states,* ***frustration*** *(top),* ***appreciation*** *(middle) and* ***internal coherence*** *(bottom): c) the ECG amplitude spectra for the real-time ECG data (10 second epochs).*

In the present paper, we provide both qualitative and quantitative measures of the information hierarchy available in both the real-time and the frequency spectrum representations of HRV data from both individual subjects and from a group of 20 subjects. In particular, we focus on (a) the degree of balance between the sympathetic and parasympathetic nervous systems, (b) the degree of entrainment between these two nervous systems at the baroreceptor system's natural rhythm (0.1 Hz) commonly called the 10 second rhythm, (c) a shift in the entrainment mode frequencies as a function of specific emotions, and (d) correlations between heart oscillator function and other body biological oscillator functions during some of these experiments. The type of intentional state changes that we focus on in this paper required the subjects to be trained in a technique for intentionally shifting their attention to the physical area of the heart and then to direct their thoughts and feelings to a specific focus. This specially designed self-management modality is called *Freeze-Frame*®(FF).[21,22] It involves feeling *appreciation* or feeling *love* for someone or something. There is also a deeper level of self management which allows one to sense a delicate balance between the two nervous systems which results in a greatly reduced amplitude in HRV oscillations. We define this as the *internal coherence* state where the intrusion of random thoughts and feelings (subjective perception) has been greatly reduced relative to the condition before FF self-management techniques were introduced.[19]

EXPERIMENTAL TECHNIQUES

Silver/silver chloride disposable electrodes were used for all ECG measurements. The positive ECG electrode was placed at the V2 position on the 4th rib and the negative near the top of the chest just under the neckline. This channel was low frequency filtered to insure an artifact-free recording for accurate calculation of pulse transit time (PTT) and HRV. Grass model 7P4 ECG amplifiers were used in the lab setting for ECG amplification. Respiration was monitored with a Resp-EZ piezoelectric belt around the chest. Where ambulatory ECG recording was required, a Del Mar Holter recording system model 363 was utilized. The HRV signal is in the form of an R-R interval tachogram. The spectral analysis of this signal was obtained from the successive discrete series of R-R duration values taken from the original ECG signal which was sampled at 128Hz. The pulse transit time interval utilized in the present study consisted of the time between the peak of the R-wave of the ECG and the appearance of the pulse wave associated with that same cardiac contraction at the index finger on the left hand with a grass model 80 sensor. All data was digitized by a Bio Pac 16 channel 16 bit digitizer and software system.[23] All post analysis of HRV, PTT, fast Fourier transforms (FFTs), power spectral density (PSD), and time domain measurements were done with DADiSP/32 digital signal processing software.[24]

For the group study, twenty individuals (10 men, 10 women, mean age 39), trained in FF and other HeartMath self-management techniques, were fitted with electrodes and were recorded for a 5 minute baseline establishment period before having them perform FF and focus on appreciation. All subjects rested for a 10 minute period before starting the baseline recording. For some readers, it may be important to recognize that no biofeedback aids were used in this study and, in fact, few if any of the subjects had any prior experience with biofeedback training of any kind. It is also important to mention that the FF technique does not involve controlled breathing and the subjects were both unaware of their breath rates and used no controlled breathing techniques.

RESULTS

Figure 2a displays, for subject A, the contrast in real-time data for three information channels when, (after a 300--second baseline), the subject intentionally invoked the FF intervention and changed states (at about 300 sec.) from a normal awake state to a heart-focused state of *appreciation.* Figures 2b and 2c display the individual power spectrum data before and after the state change, respectively, for the HRV, PTT and respiration channels. Note the frequency-locked entrainment state for these three systems in Figure 2c.

In Table I, measures of sympathetic versus parasympathetic balance, $\gamma 1/\gamma 2$, and degree of system entrainment, $\gamma 4/\gamma 3$, are given for each channel in the before and after states. Here the γ's are defined as:

> $\gamma 1$= Integral of the largely sympathetic power spectrum (0.05-0.15 Hz) [8]
> $\gamma 2$= Integral of the parasympathetic power spectrum (0.15-0.4 hz) [8]
> $\gamma 3$= Integral of the total power spectrum (0.05-0.4 Hz)
> $\gamma 4$= Integral of the power spectrum entrainment peak (at $f \pm$ 0.015 Hz)

Here, we have neglected the VLF data in the range 0 to 0.05 Hz. If one measures the standard deviation (SD) of these signals in the before and after state for each channel one notices negligible differences in spite of the markedly different trace character (Table I).

In Figure 3a, the HRV real time and frequency domain data for subject A shifting his focus of applied intentionality from *appreciation* to *love* is presented. In both states, nervous system entrainment appears to be maintained but with an attendant central frequency shift. We often see this; however, there does not appear to be any correlation between the feeling of *appreciation* and the HRV entrainment frequency between different subjects on any one day or even within the same subject from day to day.

Figure 4, from subject B, shows the HRV real-time and frequency domain data associated with the transition from an entrainment state to an internally coherent state (near zero heart rate variability). This latter is much more difficult to achieve than the former, indicating a higher degree of internal state control. In Table II, $\gamma 1/\gamma 2$, $\gamma 4/\gamma 3$, f and SD have been tabulated for both the before and after states shown in Figures 4a and 4b.

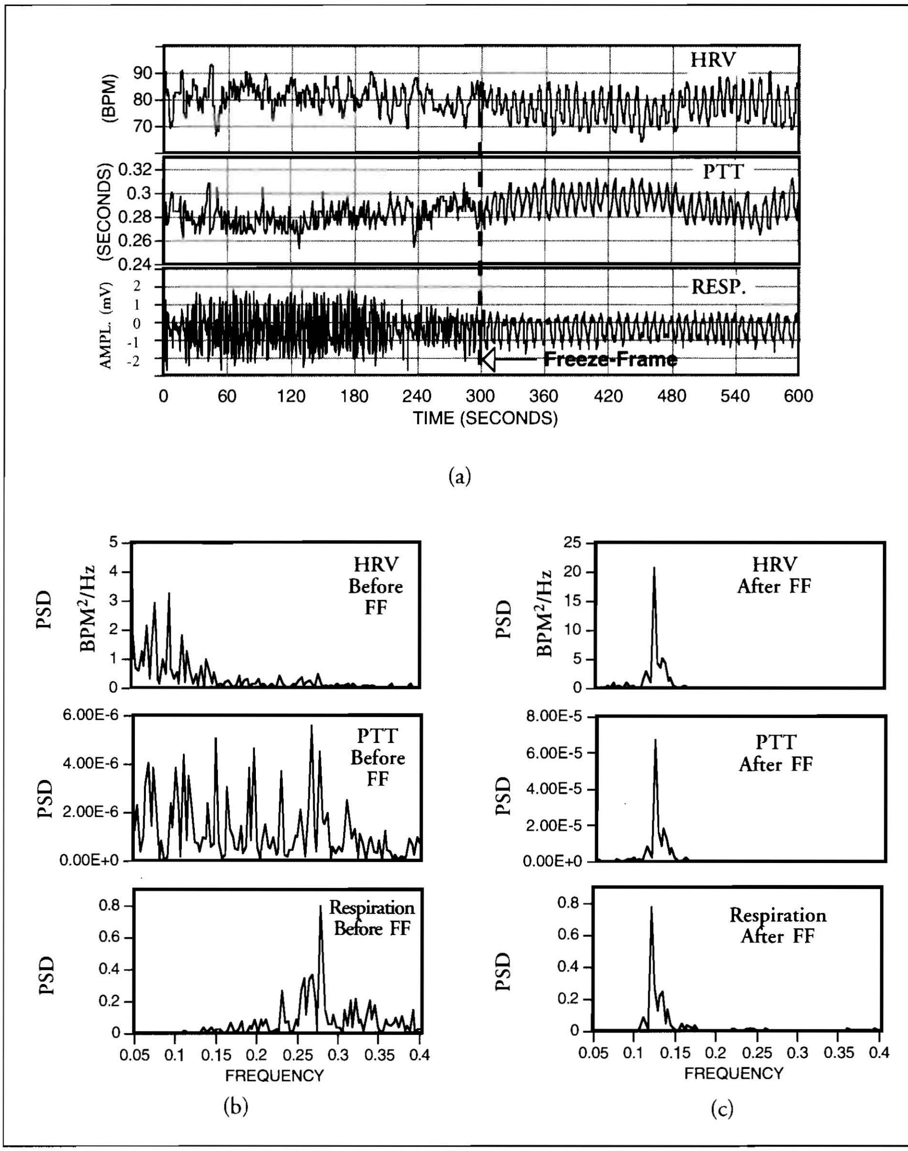


Figure 2. *Subject A: Three simultaneously recorded responses during rest followed by Freeze-Frame (FF) and shifting to a state of* ***appreciation*** *at around 300 seconds; a) real-time data for Heart Rate Variability (top), Pulse Transit Time (middle) and respiration (bottom), b) power spectra for the before FF condition, and c) power spectra for the after FF condition.*

Table I
Analysis of Subject A Data from Figure 2

	NORMAL				ENTRAINED			
	$\gamma 1/\gamma 2$	$\gamma 4/\gamma 3$	MEAN	S.D.	$\gamma 1/\gamma 2$	$\gamma 4/\gamma 3$	MEAN	S.D.
RESP	0.027	0.008	0.743	1.996	4.444	0.662	0.739	1.138
HRV	3.147	0.173	81.13	4.892	17.077	0.74	77.24	5.638
PTT	0.641	0.115	0.281	0.01	12.215	0.737	0.291	0.011

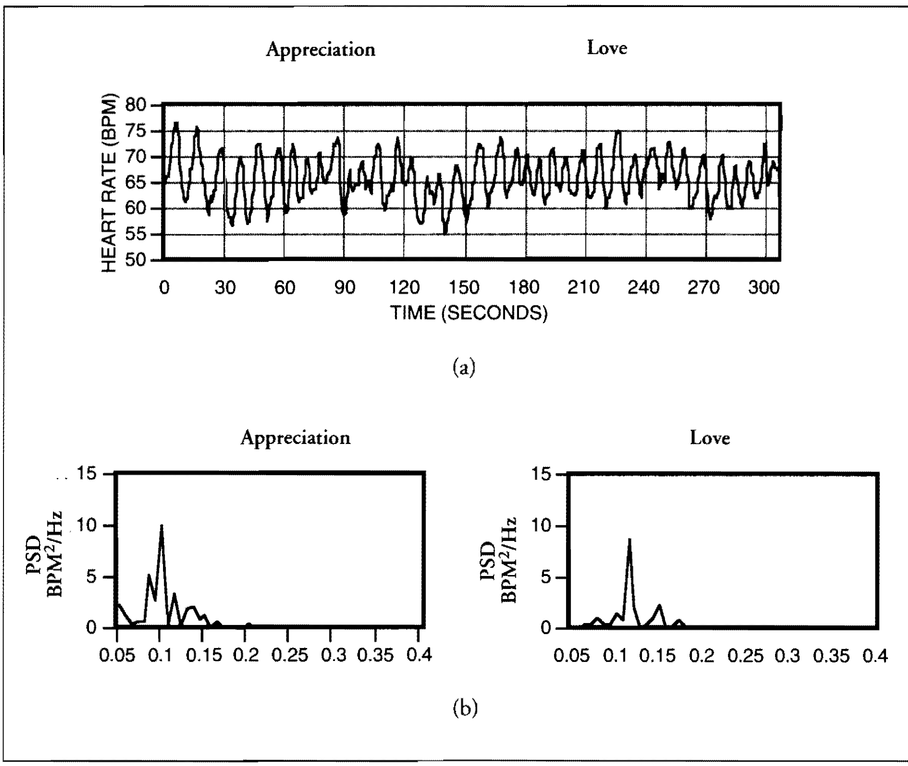


***Figure 3.** Subject A: Illustration of a shift in focus between two discrete heart intentionality states; a) real-time representation for shift from **appreciation** to **love,** and b) corresponding power spectra for the two states.*

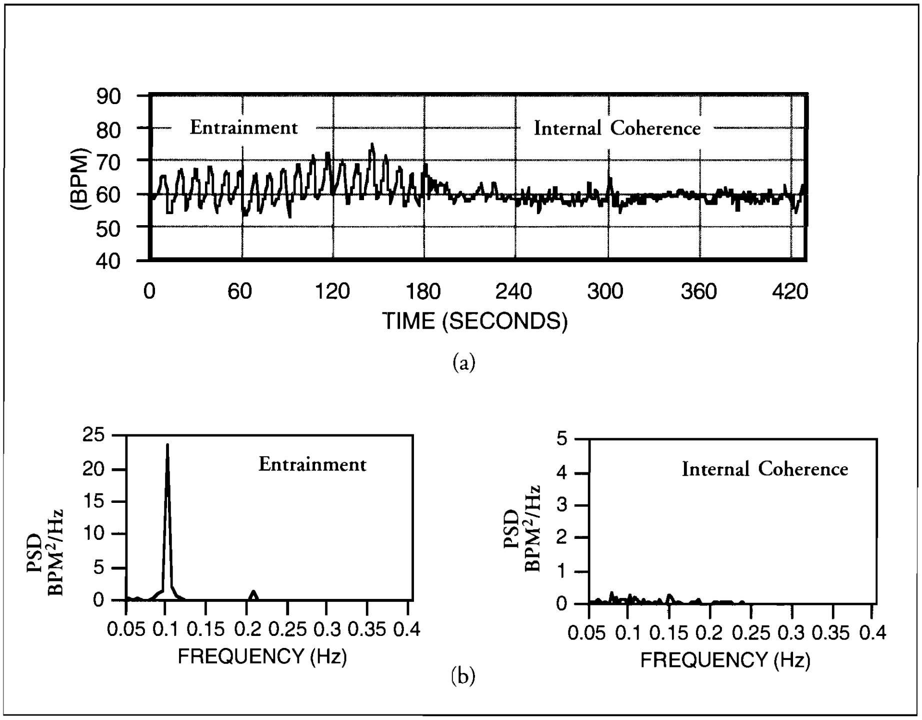


Figure 4. *Subject A: Illustration of a shift in focus between two discrete heart intentionality states; a) real-time representation for shift from* ***entrainment*** *to* ***internal coherence,*** *and b) corresponding power spectra for the two states.*

Table II
Analysis for Subject B from Figure 4

	ENTRAINED STATE				COHERENT STATE			
	γ1/γ2	γ4/γ3	f (Hz)	S.D.	γ1/γ2	γ4/γ3	f (Hz)	S.D.
HRV	16.077	0.905	0.104	4.58	1.25	0.222	n/a	1.48

In Figure 5, one sees the demonstration of subject C's ability to transition out of a specific *entrainment state* to the *coherent state,* hold the *coherent state* for a specified time period and then transition back into another *entrainment state.* The data shown in the right hand spectrum of Figure 5(b) represents the transitional change that can occur before a fully *entrained state* is reached.

Figure 6 presents a compilation of the real-time data for the twenty subjects. In Figure 6, both before-FF and after-FF data are shown.

DISCUSSION

Although a few other individuals have shown conscious heart rate control[25] it is not a normal human capacity. It is thus all the more significant to underscore the point that a set of relatively simple techniques exists[21,22] whereby otherwise

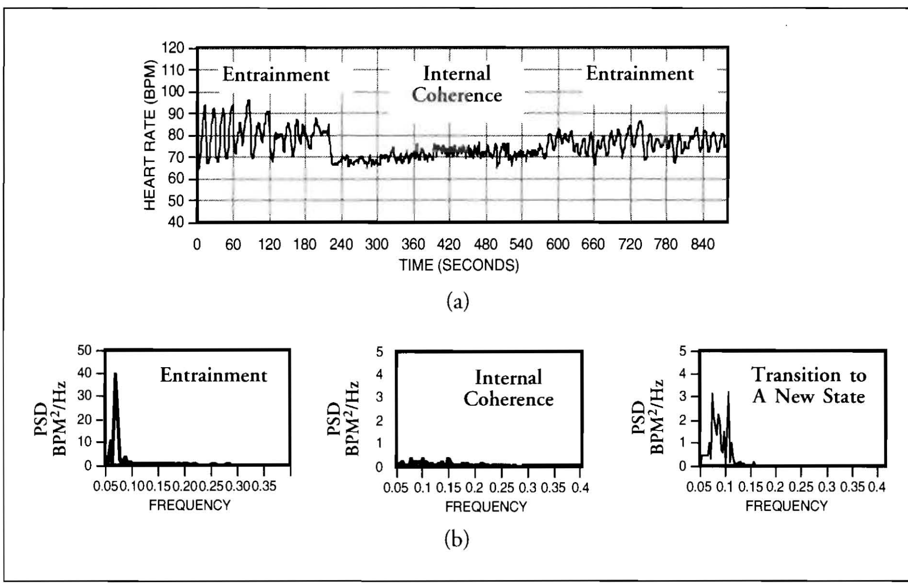


Figure 5. *Subject C: Illustration of heart intentionality focus transition in real-time from one specific entrainment state to the coherent state and then back towards another entrainment state, and (b) power spectra for the three states (Note: the ordinate scale changes).*

normal individuals can, in a reasonably short period, gain a sufficiently high level of inner self-management of their mental and emotional states which automatically manifests as increased balance and order in their ANS. With practice, the ability of subjects trained in the Freeze-Frame technique appears to grow through a series of achievement plateaus as illustrated in Figure 7. From Figure 6, we see that twenty individuals readily achieve either the "entrainment" or the "internal coherence" plateau on demand. No biofeedback of any type was involved in this data gathering. Further, these individuals had been practicing the FF technique for periods of only 6 months to 36 months. The HRV power spectra data for each of these 20 individuals was used to certify the presence of a plateau state.

Normal individuals generally exhibit imbalance in their sympathetic/parasympathetic balance so this was selected as the starting condition in Figure 7. With training, the subjects reach increased levels of mental and emotional self-management and this manifests, in this HRV study, as certain identifiable plateaus in a progress map of (1) increased sympathetic/parasympathetic balance, (2) entrainment of HRV, PTT and respiration at the natural baroreceptor frequency (0.1Hz), (3) entrainment shifts to alternate specific frequencies depending on the specific heart felt emotion focus, and (4) an internal coherent state of heart function in which the real-time HRV signal is held at an approximately zero amplitude level which means that the ECG signal is exhibiting almost perfect periodic behavior.

In physics, when one uses the word *coherence* one means a set of waves that are all in phase with each other. Here, when one uses the phrase *internal coherence state* with respect to the HRV data, one means that the variability in heart rate has fallen to almost zero or that the heart firing is almost perfectly periodic in time; *i.e.,* it is almost as coherent as it can be. In normal individuals, a consistently small or near-zero HRV wave form is an indicator of reduced ANS function.[15] However, in these trained subjects, it is an indication of exceptional self-management of their mental and emotional natures because their resting state HRV is quite large. This indicates that the prevailing medical perspective on this issue should be expanded somewhat as it appears that when a person is in a state of deep peace and inner harmony the heart shifts to a very regular and coherent rhythm.

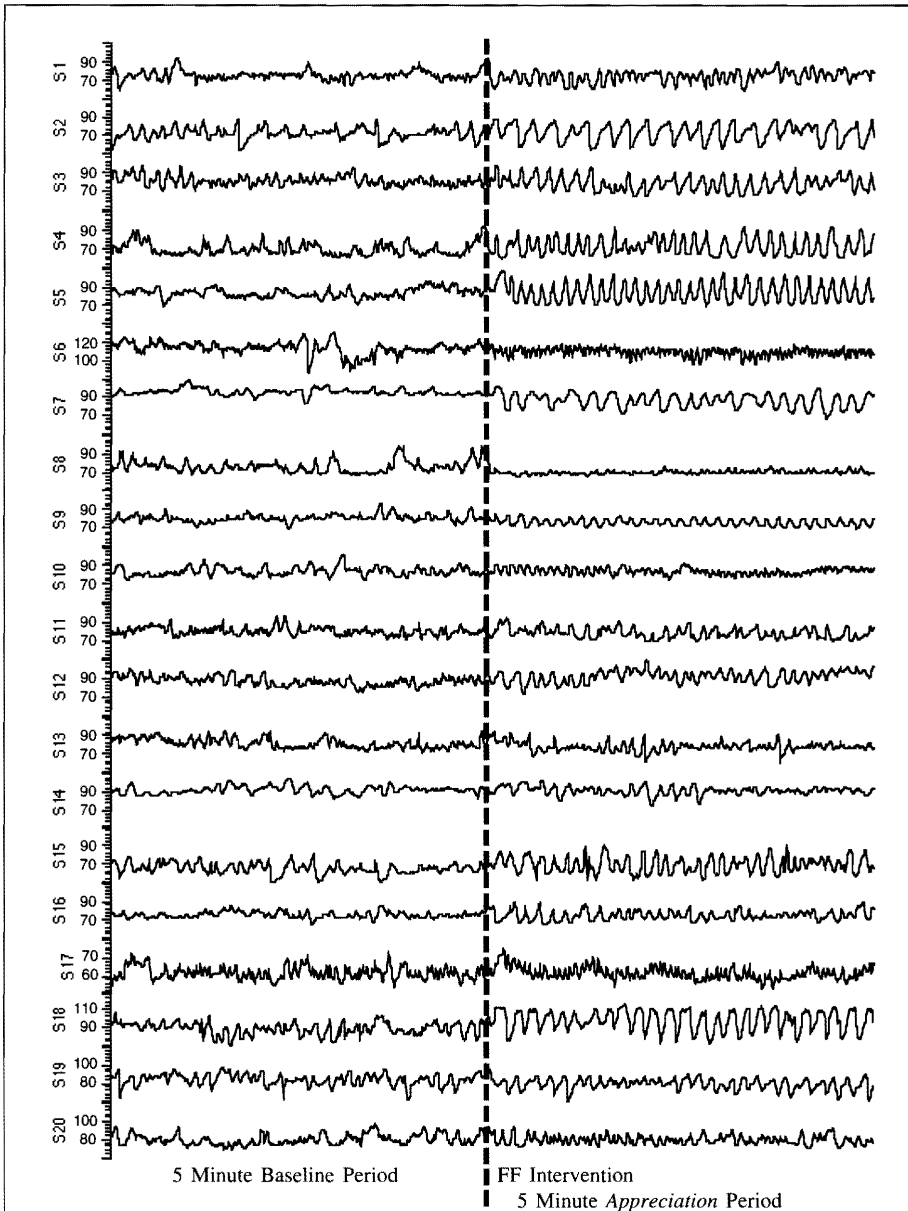


Figure 6. *Real-time HRV patterns for 20 individuals during a 5 minute baseline period, Freeze Frame inception point and a 5 minute period while focusing on* ***appreciation.***

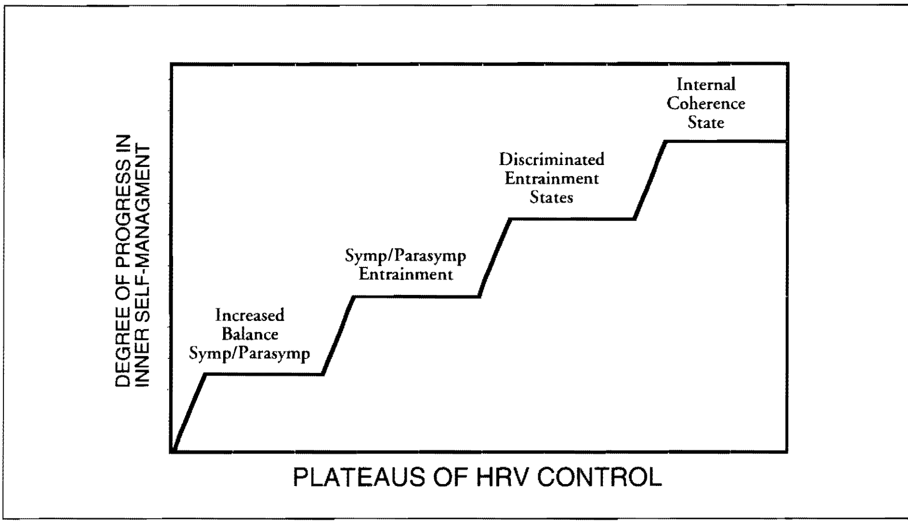


***Figure** 7. Schematic illustration of relative attainment plateaus in a progress map for subjects trained in the Freeze-Frame technique as a function of their statistical capacity to actualize their applied intentionality ability.*

The simple picture of entrainment between harmonic oscillators is of two or more mechanical or electrical systems that, in the uncoupled state, exhibit simple harmonic (sine wave) behavior of somewhat different phase and perhaps of different frequency. In the coupled state, for oscillators of the same frequency, one notices that the systems tend to phase-lock. The different body systems represented in Figure 2 can be considered as biological oscillators, but, in this case, they are not represented by a simple harmonic wave at a single frequency. Rather, they are represented by a series of sine and cosine waves of varying amplitude which represent the behavior of the different modes of oscillation of the biological oscillator. The parasympathetic branch of the autonomic nervous system (ANS) is thought to exhibit negligible amplitude in low frequency modes while the sympathetic branch is thought to exhibit negligible amplitude in the high frequency modes. After entrainment, the parasympathetic branch appears to have pumped all of its action into a particular mid frequency mode, as has the sympathetic branch. Thus, in these biological oscillators, some additional factor has intervened to shift operation into a specifically narrow set of modes and, in this narrow range of frequency, the two branches of the ANS appear to have frequency-locked and are perhaps also phase-locked. However, this type of behavior cannot be determined from a power spectrum representation of HRV data because one always loses phase information in this type of plot. Future studies should use other types of data representation to clarify this point (amplitude spectra for example).

The rather surprising result for the three biological oscillators of Figure 2, that were monitored simultaneously, is that not only do they show strong coupling but they show frequency locking. Thus, within each biological oscillator, the mode distribution activity has shifted into a very narrow frequency range which is the same for all three oscillators simultaneously.

It is important to recognize that the standard deviation quantifier of real-time HRV data is woefully inadequate to discriminate the richness of information inherent in the present studies. By shifting to $\gamma 1/\gamma 2$ and $\gamma 4/\gamma 3$ evaluations of the data, we definitely capture more of the information content inherent in the power spectrum representations of the data. However, these measures, as well, only partially display the patterns of order inherent in the data while, by personal observation, one sees that much of the information is still not acknowledged. In future studies, a better pattern recognition strategy needs to be generated.

In closing, the topic of conscious, self-intervention at the mental and emotional levels needs to be addressed. For most people, there is not a well-defined and acceptable definition of consciousness; however, most people relate the word to some association with the awake brain. Here in this paper, we have tried to show that, intentional focus solely on the heart leads to increased self-management of one's mental and emotional states that automatically manifests as more highly ordered physiological states that affect the functioning of the whole body including the brain. The practitioners of these heart focus techniques report an increased intuitive awareness and more efficient decision-making capability that is beyond their normal capacity from the mind and brain alone. This implies that consciousness is not just limited to the brain/mind interface. This is a very complex issue that will be dealt with more fully in subsequent papers; however it is hoped that we have at least broadened the perspective of what one might think of as consciousness and the ways that it can be intentionally directed to increase one's awareness. By bringing more self-management into one's mental and emotional world where we experience our fears, frustrations, and anxieties, we can learn to transform them into more joy, fun, peace, and inner fulfillment.

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10. Explanation of Terms for ECG and HRV Data:
    Fourier Transform: The time domain signal is analyzed into its primary wave components (Fourier's method of decomposition). The amplitude of each wave component is determined by this method as a function of wave frequency. The specific mathematical representation of this basic time domain data as frequency domain data is called the Fourier Transform.
    Power Spectral Density (PSD): The energy or power of a wave is proportional to the square of its amplitude. The power spectrum of a signal is thus a plot of the wave amplitude squared for each component as a function of frequency of that component. When this plot is in units of energy per hertz, we have the PSD which is the wave power present in a small frequency range, Δf, as a function of frequency, f.
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19. Explanation of terms:

Appreciation is defined as the state in which the subject has clear perception or recognition of the feelings of sincere *appreciation* for someone or something. It is the heart-focused feeling of *appreciation* that is associated with the HRV changes reported on in this paper, as contrasted with the mental concept of *appreciation* which does not produce such HRV changes.

Love is defined in this context as the benevolent heart focus concern for the well-being of others. As with *appreciation,* it is the true sincere feeling state of *love* that is associated with the HRV changes reported in this paper.

Internal coherence is the term used to define a particular state reached through practice of the *Freeze-Frame* technique. As one practices *Freeze-Frame,* a conscious awareness of one's own electrical body and its minute current flows is reached. The ability to focus in the heart area and balance these electrical energies brings about the *internal coherence* state which automatically lowers one's HRV to the degree that a truly harmonic series of signals is produced in the frequency domain of the ECG [See R. McCraty, M. Atkinson & G. Rein, ECG Spectra: the Measurement of Coherent and Incoherent Frequencies and their Relationship to Mental and Emotional States, *Proceedings of the ISSSEEM Conference* (1993), pp. 44-48.] The inability of a normal individual's heart rate to rapidly change in response to the needs of the system as a whole, in the moment, could be viewed as a loss of flexibility to changing conditions. Chronic loss of HRV has been linked to aging,[12] greater risk of sudden death (heart attacks),[15] diabetes,[12] and lowered hormonal response.[25] It is worth noting that the *internal coherence* state is accompanied by a large reduction in HRV during the time the individual is maintaining that state; however, these same individuals normally have large and healthy HRV responses and are able to change back and forth at will. Almost all the subjects who manifest this state report that they are in a calm, peaceful and highly intuitive inner state.

Biological oscillators: When the instantaneous systemic arterial pressure (SAP) is continuously recorded, fluctuations with each heart beat and with each breath are always seen. This rhythmic activity in the autonomic nervous system appears to be controlled by at least three biological oscillator systems: (1) centrogenic rhythms in brainstem networks with faculta-

tive coupling (entrainment) with the respiratory oscillator, (2) the baroreceptor feedback network and, (3) the autorhythmicity of the vascular smooth muscle [See H. P. Koepchen, referred to below]. The fact that each of the oscillators can develop different frequencies and that the phase-lags between the oscillations are variable, easily explains the general experience that blood pressure waves are quite variable and can appear or disappear in an unpredictable manner. The existence of several oscillators with similar basic frequencies enables synchronization and resonance between oscillators. Thus, we can assume that states of regular steady blood pressure waves are the expression of the entrained action of the complex multi-oscillatory system. [See H. P. Koepchen, History of Studies and Concepts of Blood Pressure Waves, In *Mechanisms of Blood Pressure Waves* (K. Miyakawa *et al.*, Ed., Japan Scientific Society Press, Tokyo/Springer-Verlag, Berlin, 1984), pp. 3-21; C. Polosa, Rhythms in the Activity of the Autonomic Nervous System: Their Role in the Generation of Systemic Arterial Pressure Wave, Ibid., pp. 27-41, Ibid., pp. 43-56.]

Arterial pulse transit time is a measure of the speed of travel of the arterial pulse wave from the heart to some peripheral recording site. It is used as a non-invasive method to monitor the elasticity of the artery walls and indicate changes in blood pressure on a beat-to-beat time-frame. The arterial pressure pulse is a wave of pressure which passes rapidly along the arterial system. The pulse wave velocity (4 to 5 *m* per second) is much faster than the velocity of blood flow (less than 0.5 *m* per second). The pulse wave velocity varies directly with pressure-related changes in the elasticity of the arterial wall. [See M. H. Pollak & P. A. Obrist, Aortic-Radial Pulse Transit Time and ECG Q-Wave to Radial Pulse Wave Interval as Indices of Beat-By-Beat Blood Pressure Change, *Psychophysiology* **20**, 1 (1983), pp. 21-28]. The more rigid or contracted the arterial wall, the faster the wave velocity. From this, it follows that PTT should vary inversely with blood pressure. Common estimates of the magnitude of this effect suggest that PTT varies by about 1*ms* per *mm* Hg change in pressure. [See R. J. Barry & F. H. Mitchell, A Comparison of Phasic Cardiac Responses Derived from the Electrocardiogram and the Peripheral Pulse, *International Journal Psychophysiology* 5 (1987), pp. 73-78.]

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21. D. L. Childre, *Freeze Frame®, Fast Action Stress Relief* (Planetary Publications, Boulder Creek, CA, 1994). *[Author's Note: Freeze-Frame®* is one of the tools used in the HeartMath system of self-management. It consists of consciously disengaging the mental and emotional reactions to either external or internal events and then shifting the center of attention from the mind and emotions to the physical area around the heart while focusing on someone or something to *love* and/or *appreciate.* This allows the individual to access a wider and more objective perception in the moment.]
22. S. Paddison, *The Hidden Power of the Heart* (Planetary Publications, Boulder Creek, CA, 1992), pp. 95-110.
23. BIOPACK Systems, Inc., 275 South Orange Avenue, Ste E, Goleta, CA 93117.
24. DSP Development Corporation, One Kendall Square, Cambridge, MA 02139.
25. E. Green & A. Green, *Beyond Biofeedback* (Delacorte Press, Seymour Lawrence, NY, 1977), p. 201.

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