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Overview of the Heart's Intelligence: A Dynamic Perspective Into the World of Energetic Wellness

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Abbreviations

ANS	**Autonomic Nervous System**
EMF	**Electromagnetic field**
HMI	**HeartMath Institute**
HR	**Heart rate**
HRV	**Heart Rate Variability**
ICNS	**Intrinsic Cardiac Nervous System**

Abstract

Research over the last 30 years has begun to explore the intrinsic relationship between biology and quantum mechanics, leading to the new science of *quantum biology*. The convergence of these 2 seemingly disparate disciplines has revolutionized current thought on biophysiology and overall health and wellness. Important concepts covered in this review are the sensory and intuitive intelligence of the heart, the phenomenon of coherence, heart rate variability (HRV) and the creation of heart rhythms, the dynamic role of the autonomic nervous system (ANS), and the bidirectional communication network between the heart and the brain. Neurocardiology and psychoneurophysiology come into play, as well as electromagnetic fields (EMFs), biofield physiology, and quantum mechanics.

This paper provides an overview of the heart as a physiological and sensory organ at the seat of innate intuitive intelligence. The energetic nature of the heart co-creates the ability to build resilience, and establishing emotional self-regulation is the basis for achieving systems-wide coherence and optimal states of wellbeing for people and those that surround them, both human and animal.

Introduction

Over the last millennium, ancient and indigenous cultures have embraced the heart as the source of emotion, intuition, and wisdom. Science is now catching up to the inner workings of this profound understanding. *Heart intelligence* is a term used to describe the conceptual framework of the innate intuitive intelligence that resides within us as the mind and emotions are brought into a synchronous alignment with the energetic heart. Over the last 30 to 40 years, research has explored the physiological mechanisms by which the heart and brain communicate and how the activity of the heart influences emotions, perceptions, intuition, and overall health and wellbeing.

Basic cardiac physiology such as the functions and sounds of the closing of the valves, the calculation of beats per minute, and the recognition of rhythms based upon the ECG are well established. However, not only is the heart an efficient mechanical pump, but it also contains a self-regulatory, autogenerated electric system, an endocrine system, and a neurological system. The synchronous activity of heart muscles produces the strongest rhythmic electromagnetic field (EMF) in the body (1, 2). It is within this EMF that bioenergetic information is encoded and transmitted. The EMF functions

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as a carrier wave, similar to the way sounds and images are transmitted to a cell phone via microwaves. These concepts are supported within the vast amount of research in the multidisciplinary fields of subtle energy medicine, biofield science, and quantum electrodynamics, all beyond the scope of this paper (3, 4).

The concept of coherence and its actualization is an important factor in the facilitation of an overall state of wellbeing. Coherence can be defined as the synchronization between different oscillating systems or the physiologic degree of order, harmony, and stability in various rhythmic activities in living systems over any given period of time (4). It occurs when the heart, brain, autonomic nervous system (ANS), immune system, endocrine system, thoughts, and emotions are in alignment. Research has shown that when psychophysiological coherence is activated, physiological systems function more efficiently and emotional stability, mental clarity, and cognitive function all improve. Studies in the detection of heart rhythms, extrapolated using heart rate variability (HRV), have established that a physiologic state of coherence generates the clearest and smoothest electromagnetic signals emitted from the heart (4, 5).

The heart works in concert with the regulation and synchronization of other physiological systems including blood pressure, hormones, autonomic nervous function, immune modulation, epigenetic expressions, and the connection to quantum biology. The emerging science of quantum biology is generally defined as the applications and relationships of quantum mechanics and theoretical chemistry to biological systems (6, 7).

The heart plays a central role in creating physiological coherence individually, socially, and globally, and is associated with heartfelt positive emotions and intuition (4, 5, 8). As one cannot directly measure, touch, or see thoughts, emotions, or intuition, the functions of these energetic systems have been demonstrated using technology designed to evaluate the amount of coherence. Measurements are based on a complex mathematical model of the relationships between HRV, respiration, blood pressure, skin conductance, and the subtle underlying electrophysiological mechanisms reflected in heart rhythms, identified as resonant *heart frequencies* (5, 8).

The intimate connection between emotions and bodily functions has been extensively studied. It has been shown that emotions affect regulatory systems such as the ANS, blood pressure, and hormone levels. These effects can be demonstrated with EEGs, skin conduction tests, and ECGs. Decades of research have shown that HRV and associated heart rhythms stand out as the most dynamic and reflective indicators of both emotional states and overall health (4, 5, 8, 9). Over the last 30 years, research into the heart's intelligence has uncovered the fundamental existence of a deeper relationship that goes beyond the basic understanding of the heart as a mechanical pump. As structure becomes function and function becomes form, within the form the cellular, molecular, atomic, and subatomic worlds are uncovered. Modern quantum mechanics, as applied to biology, is a body of physical principles combining the elements of quantum mechanics with the behavior of subatomic particles and their interactions via a variety of force fields such as EMFs, and the relationships between patterns of EMFs, frequencies, and vibrations (7). Combining quantum mechanics theory with the mechanisms of synchronistic orchestration of physiologic oscillating frequencies, at an atomic core level biophysiology is more energy and less matter (4, 6, 7). From this perspective, the understanding of the intertwined and entangled relationships to frequency and resonance exemplifies connections within one's biophysiology—individually, socially, and globally.

The Heart as a Sensory Organ

Neurocardiology

When neurophysiologists and neuroanatomists joined forces with a group of cardiologists in the early 1990's, the new discipline of neurocardiology was conceived. It was found that the heart has a complex neural network sufficiently extensive as to be classified as the "little brain" in the heart. Within the heart are approximately 40,000 ganglia that are locally distributed around major vessels. Although neurons in the heart are structurally similar to those in the brain, they are technically considered ganglia due to semantics that defines any cluster of nerves outside the CNS as ganglia (9).

The anatomy and functions of the heart brain, or the *intrinsic cardiac nervous system* (ICNS), and its connection to the brain have been extensively studied by neurocardiologists. The ICNS is an intricate network of complex ganglia, proteins, and support cells. Also, though not typically considered an endocrine gland, the heart does manufacture and secrete hormones and neurotransmitters (9–11). The heart's neural circuitry enables it to act independently of the central brain to learn, remember, feel, and sense (12, 13). This becomes more apparent when looking at research around intuition. Interestingly, this phenomenon of cellular memory has been recognized in some heart transplant recipients who find they have the memories, dreams, food cravings, hobby

preferences, musical talents, and even foreign-language speaking abilities of the donor (13, 14).

Once the information has been processed by the ICNS, signals are sent to the sinoatrial node and other tissues of the heart. The neural output from the ICNS then reaches the brain via ascending pathways in the spinal column and vagus nerve. These messages travel to the medulla, hypothalamus, thalamus, amygdala, and then to the cerebral cortex (15–18). Thus, the afferent information processed by the ICNS can influence activity in the higher brain centers affecting cognition, attention levels, motivation, perceptual sensitivity, and emotional processing (19–23).

Heart Hormones

In 1983 the heart was reclassified as part of the hormonal system when atrial natriuretic peptide secreted by the atria was discovered (4, 24, 25). This hormone plays a role in fluid and electrolyte balance, regulation of blood vessels, kidneys, and adrenal glands, and also in many regulatory centers in the brain. It inhibits the release of stress hormones and sympathetic outflow.

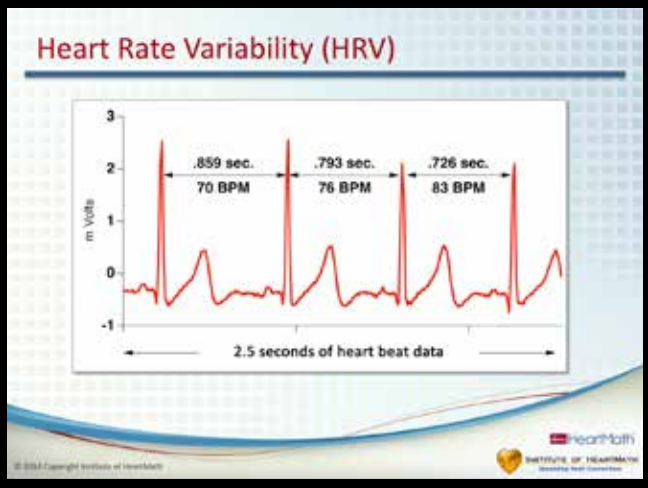
The heart also synthesizes and releases catecholamines like norepinephrine, epinephrine, and dopamine (4, 26, 27). It is interesting to note that although dopamine is classified as a catecholamine, it is not associated with hormones of stress, but rather is classified as a feel-good neurotransmitter. Oxytocin, once believed to be produced only in the brain, is also manufactured and secreted by the heart in the same, if not higher, concentrations. This hormone is considered the love or bonding hormone, and its secretion is involved with cognition, tolerance, trust, friendship, and the establishment of enduring pair bonds in both animals and humans (4, 28, 29).

The Autonomic Nervous System and Heart Rate Variability

The ANS is the part of the nervous system responsible for 90% of the involuntary control of the body's internal functions. It controls heart rate (HR), blood pressure, vascular tone, GI function and motility, glandular secretions, hormone fluctuations, immune responses, respiration, and bronchiole functions. Although respiration is under involuntary mechanisms, mindful breathing and other breathwork have been utilized consciously to augment healing (30).

The HRV is classified as a measure of the natural beat-to-beat interval between each heartbeat, or more specifically between the QRS complexes (**Figure 1**). Within any given timeline, the HR increases and decreases in response to the input of the sympathetic and parasympathetic nervous systems, respectively. This pattern of HR acceleration and deceleration is the basis of the heart's rhythm as a function of HRV (4, 31). In essence, HRV is a function of the net neural input and synergistic balance between the sympathetic and parasympathetic branches of the ANS. Most physical examinations classify the status of the heart through its sound, rhythm, and rate in beats per minute. The interpretation of those parameters and their relationship to the system has provided a historically satisfactory measurement of health. However, it is the level of HRV within an organism that is reflective of the true state of optimal healthy function.

Figure 1



HRV diagram showing the inter-beat time variation between QRS complexes
Image is courtesy of the HeartMath Institute (HMI). www.heartmath.org

Investigation of the heart's complex rhythms as a result of HRV began with the emergence of modern signal processing over 50 years ago (4, 32). The fluctuations in HR result from complex, non-linear, coordinated interactions among several physiological systems, including thoughts and emotions. It is important to note that there is a natural rhythm between the HR and the amount of HRV. As previously stated, the estimated HRV at any given time represents the net effect of neural input of the parasympathetic and sympathetic nerves. As HR increases, there is less time between beats for variability to occur, and as the HR decreases, there is more time between beats, so variability naturally results (4).

HRV is an important indicator of health as a marker of physiological resilience and emotional flexibility, making it a reliable predictor of future health problems (32, 33).

A decrease in HRV is associated with an increase in various disease states, and conversely, a healthy system correlates with an increase in HRV. It is the balance of the neurologic input between the parasympathetic and

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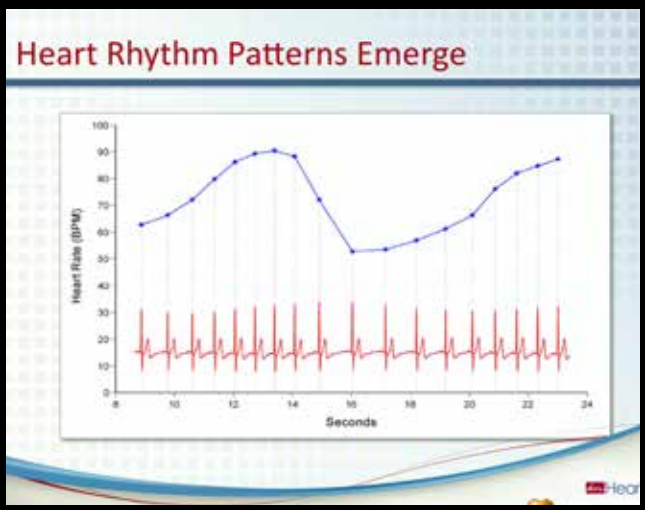
sympathetic branches of the ANS that creates the increase in HRV. Subsequently, an imbalance of function between the branches decreases HRV and has been implicated in a wide variety of pathologies. Decreased HRV is predictive of increased risk of heart disease, sudden cardiac death, and all-cause mortality (4, 33, 34). Too much variation and instability, leading to arrhythmias and nervous system chaos, is equally detrimental, possibly indicating chronic stress, age-related depletion, and/or pathologic or poorly functional regulatory systems. In essence, reduced HRV may correlate with disease and mortality because it reflects a reduced regulatory capacity and ability to respond to physiological, emotional, and psychological challenges (4, 35, 36).

The ANS is a complex system that uses diverse neurotransmitters and electrochemical signals to maintain a state of homeostasis. It is the continual dynamic balance and interplay of both the sympathetic (fight or flight) and the parasympathetic (rest and digest) systems that allow for the greatest HRV and support the ability to regulate complex non-linear interactions among different physiological systems. When measured, this is portrayed as sinusoidal-like rhythms that are created in accordance with the increase and decrease of the heartbeat in response to sympathetic and parasympathetic signaling (**Figure 2**). Research has shown that a smooth waveform is correlated with a high degree of coherence (4, 8, 24, 31, 37).

Figure 2



HRV is a measure of a normally occurring beat-to-beat change in heart rate. The ECG is shown at the bottom, and the instantaneous heart rate is represented by the blue line. The pattern of heart rate acceleration and deceleration is the basis of the heart rhythms.

Image is courtesy of the HMI. www.heartmath.org

The Vagus Nerve

The Latin meaning for the term vaga is *wandering*, an appropriate designation for the vagus nerve due to its wide distribution throughout the body. The vagus (cranial nerve X) is the longest nerve, arising from the medulla oblongata with many branches which extend into the ear, the larynx, and caudally as far as the celiac plexus and sacrum. As the vagus nerve is largely responsible for the control of the parasympathetic nervous system, its activation is primarily responsible for parasympathetic tone (38).

The evolution of the vagus nerve is central to the development of emotional and social experiences and the ability to self-regulate emotional processes, access creativity, achieve higher cognition, and make complex decisions (4, 37). The vagus nerve innervates the motor neurons in the ICNS, neurons which connect directly to the sinoatrial and atrioventricular nodes to slow the heart rate and increase bronchiolar tone. It is the coordinated and integrated sympathetic and parasympathetic activity within the cardiopulmonary system that ultimately contributes to the beat-to-beat cardiac functional changes. It is generally well known that the efferent (descending) pathways in the ANS are involved in the regulation of the heart; however, in this bi-directional communication between the heart and the brain, it is the heart that sends 90% of the afferent (ascending) parasympathetic activity to the brain via the medulla oblongata, bridging further communication into higher cortical regions. This means that the heart sends more information to the brain than the brain sends to the heart (24, 39). Although the ANS is known to be a system that operates without conscious control, it is clear that thoughts and even subtle emotions influence its activity. Many research studies from the HeartMath Institute (HMI) have examined the influences of emotions on the ANS, utilizing analysis of HRV/heart rhythms and the reflections of heart-brain interactions and ANS dynamics (4, 15, 37, 40).

Heart-Brain Connection and Coherence

Heart-Brain Connection

The relationship of the CNS and the ANS to the heart and control of cardiac rhythms is intricate and complex involving higher cortical functional interrelations between the limbic system, the neocortex, and medulla; chemoreceptors and baroreceptors from the heart, lungs, and face; and mechanosensory and chemosensory neurons within the ICNS (4, 9, 10).

Scientific research on the communication between the heart and brain was first conducted by John and Beatrice Lacey throughout the 1960's and 70's (12). Studies

undertaken over the last 30 to 40 years have brought to awareness the profound relationship between the heart and brain, exemplifying the importance of clear communication facilitated by physiological, emotional, and energetic pathways. The communication is a dynamic 2-way dialogue, with each organ influencing the other's function and each of their functions influencing the body and other biological processes. The 4 basic ways the heart communicates with the brain are neurologically through the nervous system, biochemically through hormones, biophysically through pulse waves, and energetically through sound waves and EMFs (4).

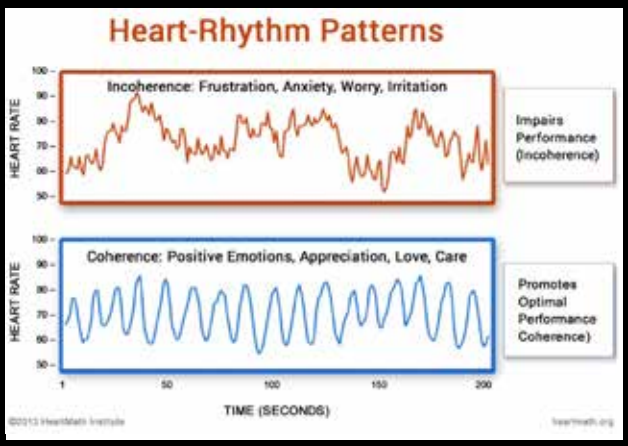
Although the heart has been considered the seat of emotions and feelings and the brain has been considered the seat of thinking and intellect, neuroscience research has shown that the relationship between the neural connections of the cognitive neocortex and subcortical emotional centers such as the amygdala, thalamus, hypothalamus, and the body are integrated into a conversation that is strongly influenced by emotions (4, 19, 24, 41). The link between the emotional (subcortical) and cognitive (cortical) areas led to the introduction of the concept of emotional intelligence in the 1990's and exemplified the important link between mind and emotions, ie, what is thought and what is felt (4, 41). Many studies have shown that when the mind and emotions are in sync, individuals are more self-secure and aligned with deeper core values, enabling responses to stressful situations with increased resilience and inner balance (4).

Coherence

The smooth flow of information and clear communication is represented by the concept of coherence. As defined earlier in the introduction, coherence can be defined as the synchronization between different oscillating systems or the physiologic degree of order, harmony, and stability in various rhythmic activities in living systems over any given period (4). When there is energetic harmony between the heart and brain, the signal is clear and the rest of the bodily functions fall into a synchronized rhythm which becomes a state of entrainment. In other words, the rhythms of various oscillating systems, those that exhibit a physiologic degree of order, harmony, and stability in various rhythmic activities in living systems over any given period of time, become aligned. This harmonious order signifies a coherent system whose efficient and optimal function is directly related to the ease and flow of life processes, as opposed to an erratic and discordant pattern denoting an incoherent system reflective of stress and inefficient use of energy (4, 40).

In these states of coherence, there is an increase in parasympathetic activity or vagal tone, heart-brain synchronization, and HRV, allowing body systems to function with a high degree of harmony and efficiency while facilitating natural regenerative processes. Research conducted on breathing and visualization techniques designed and implemented by the HMI has found that extended periods of coherence can be achieved by actively generating positive emotions (**Figure 3**) (4, 42–44).

Figure 3



Heart rhythm patterns in relation to emotions
Image is courtesy of the HMI. www.heartmath.org

Psychoneurophysiology- How Emotions Affect Coherence

There is a large body of research from the last century in multidisciplinary fields supporting the concept that positive emotions have a beneficial effect on mental and physical health (4, 45). Although backed by science, this concept is also intuitively understood, as elevated emotions create increased energy and physical expressions of positivity. Universal vibrations, frequencies, and resonances as perceived by engineer and scientist Nikola Tesla constitute the core of a new conceptual and experimental perspective on human consciousness and emotions (45).

Emotions, or *E-motions* as they can be called, are actually *energy in motion*. Each emotion correlates with a resonant vibration. The more elevated the emotions, the higher or faster the frequency. The more depleted the emotion, the lower or slower the frequency. Research models of coherence show that positive emotions tend to increase the synchronization between body systems, which is also reflected in state-specific patterns of heart rhythms. Negative or lower vibration emotions such as anger, fear, anxiety, depression, frustration, judgment, and hate carry a chaotic, distorted signal, whereas positive or higher vibrational emotions such

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as gratitude, care, appreciation, love, and joy carry a smooth, organized signal (**Figure 3)** (4, 37). A physiological state of entrainment, defined as 2 or more oscillating systems shifting into the same frequency, is found to occur when individuals move into a physiologic state of coherence (37) (**Figure 4**).

Emotions and thoughts drive physiology, as exemplified in the fields of psychoneurophysiology and psychopharmacology. For every emotion, there is a single neuropeptide that matches that emotion, and other biochemicals are released into the body in response (46–48). Self-regulation through the emotional landscape has been the paramount motivating principle for the HMI to demonstrate the beneficial effects on stress management, enhancement of human performance, and optimal wellness. Dr. Rollin McCraty, head of research at HMI, states that failures of self-regulation are central to the vast majority of health and social problems that plague modern societies, and the most important strength to build for the majority of people is the capacity to self-regulate their emotions, attitudes, and behaviors (4). The author concludes that as individuals make conscious decisions and discern their emotional responses, they tap into the intuitive wisdom of the heart's intelligence for guidance. Accessing that energetic place of intuition enables an increase in connection and allows more resonance with the surrounding quantum field of information.

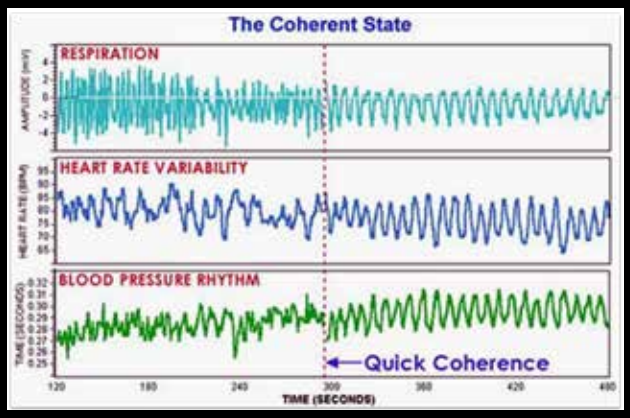
Electromagnetic Fields and Quantum Resonance Coupling

Electromagnetic Fields

The first law of motion from Newtonian classical physics states that an object in motion tends to stay in motion unless an external force acts upon it. However, according to the world of subatomic particles and quantum mechanics, motion is a constant and the direction or quality of the movement is dependent upon the forces that act or do not act upon it. Subatomic particles are always in motion, and all things are made of subatomic particles (4, 6, 7). A fluctuating EMF is produced when the negative charge of an electron and the positive charge of a proton interact. Each atom, molecule, and cell generates an EMF. The heart is the most powerful source of electromagnetic energy in the human body (49, 50). Its electric field has been measured to be 100 times greater, and its magnetic field 5000 times greater, than the brain. Using a magnetocardiogram and a superconducting quantum interference device (SQUID), the heart's rhythmic magnetic field can be measured several feet away from the body and shown to extend out in all directions. The heart's field is an important carrier of information (**Figure 5**) (4, 44).

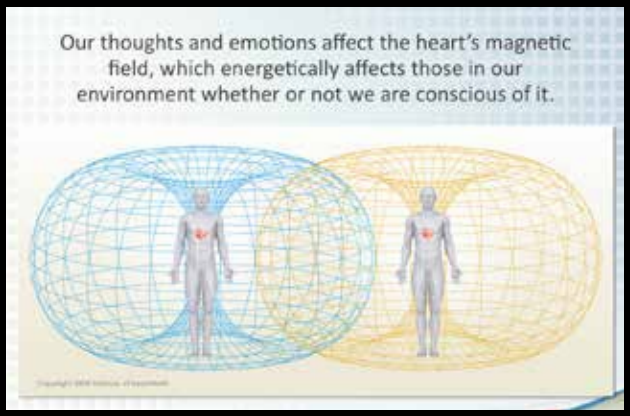
Just as the purpose of a gland is hormone secretion or the ears is sound detection, the purpose of the electromagnetic biofield is the creation of a conduit to connect energetic information with the wider world. This connection can affect other humans and animals. Within these EMFs are signals and messages that are encoded and transmitted within physiological systems in the language of patterns. We see these patterns as time intervals between action potentials, hormonal pulses, and even the inter-beat intervals of the pressure, sound, and electromagnetic waves produced by the heart. It is the rhythmically pulsing waves of electromagnetic energy generated by the heart that create fields within fields and interact with electromagnetically polarized tissues, molecules, and subatomic particles throughout the body (3, 4, 37, 49).

Figure 4



Change in waveform patterns and entrainment between respiration, heart rate variability, and blood pressure before and after a Quick Coherence technique.
Image is courtesy of the HMI. www.heartmath.org

Figure 5

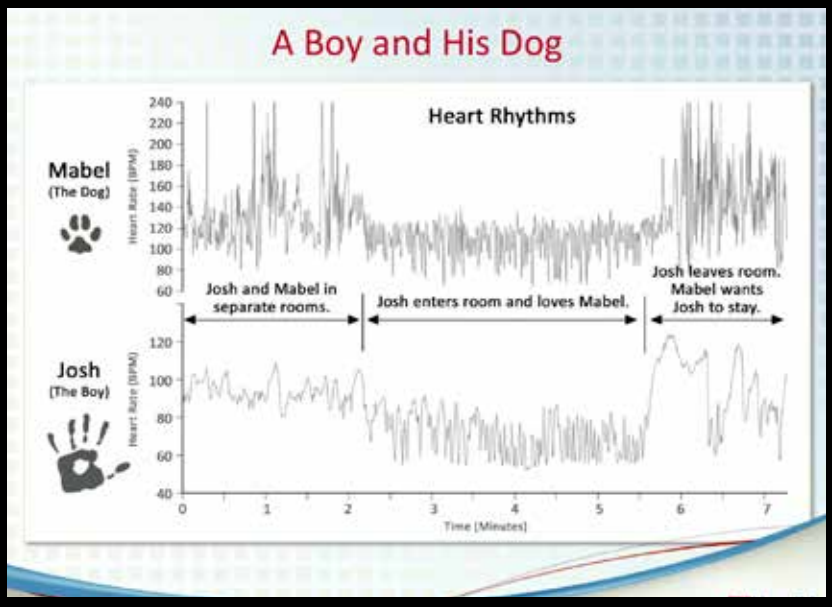


The natural toroidal shape of the electromagnetic field produced by the heart and its relation to others.
Image is courtesy of the HMI. www.heartmath.org

Studies have shown a direct correlation between the patterns in HRV rhythms and the frequency spectrum patterns of the ECG or magnetocardiogram. These findings indicate that psychophysiological information can be encoded into the EMFs produced by the heart and that the heart's EMF becomes more organized during positive emotional (heart coherent) states, potentiallyincreasing its capacity to impact surrounding endogenous tissues or exogenous systems (4). As emotions are energy in motion, they are part of the information system and help create the quality of the signal. Elevated emotions create a more organized, harmonious, smooth, rhythmic, higher amplitude waveform that is not only emitted but can also serve as an interference pattern to transmute incoming frequencies and energies (4, 8, 24, 37). In this author's interpretation, it is transforming "bad vibes" into "good vibes."

In the 1969 paper "Psychophysiological Basis of Emotion," neurosurgeon Karl Pribram commented on the connection between the heart and the brain. He stated that low-frequency oscillations generated by the heart and body in the form of afferent neural, hormonal, and electrical patterns are the carriers of emotional information and that the higher frequency oscillations found in the EEG reflect conscious perception and labeling of feelings and emotions (51). In recent years, it has been proposed by the HMI that these same rhythmic patterns not only transmit emotional information via the EMF into the environment and can be detected by others, but that these can be processed in the same manner as internally generated signals (4, 5, 37). This author postulates that this is one of the mechanisms by which disease states can be shared between species, through biofield physiology and epigenetic mechanisms fostered by emotional relevancy and interconnectedness (**Figure 6**).

Figure 6



Synchronization of heart rhythms between Josh and his dog Mable after Josh goes into a state of coherence and radiates loving emotions to Mable.
Image is courtesy of the HMI. www.heartmath.org

Quantum Resonance Coupling

Quantum coupling and resonance theory are part of an expanded discussion about the connection human beings have with the oneness of the origins of the universe and the invisible quantum field or matrix. Facilitating this connection with intuition and heart intelligence is part of the meditative practices and wisdom traditions of people and cultures all over the world.

The theory of heart intelligence continues to bridge the gap between science and spirituality, as science uses quantum mechanics to delve into understanding the connection to oneness and perhaps divine source. This theory became the foundation of a groundbreaking experiment from the HMI titled "Modulation of DNA Conformation by Heart-Focused Intention" (52). In essence, the study was designed to see what effect conscious intention, together with heart coherence, had on the unwinding of a strand of DNA. The hypothesis for the experiment by Doc Childe, founder of the HMI, was that heart intelligence and EMFs act as carriers of energetic connection or coupling of information via resonance mechanisms occurring between higher dimensional structures (higher self or spirit) maintained in the quantum field and the physical DNA in our cells. These higher dimensional structures are proposed to communicate information to DNA, guiding cell organization and differentiation and setting boundaries for the individual organism's ability to vary in its physical, mental, and emotional domains.

The results of the study were significantly relevant, showing that the group that generated the highest heart coherence ratios, coupled with intention, created a 25% increase in the unwinding of the DNA structure as compared to the control group with a 1.09% change (52). This study strongly established the plausibility of the power of elevated emotions, heart coherence, and intention as an effectual construct

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in the alteration of DNA. New types of healing may be possible with these tools if one can learn to influence the unwinding of DNA and harness the power of emotions to affect epigenetics, up-regulate genes, and influence the expression of proteins.

Conclusion

Recognizing the intimate relationships humans have with their hearts and seeing the much bigger picture that exists leads to realizing the power that can be harnessed to support and facilitate the healing of oneself and potentially the healing of others. This recognition goes beyond the linear, biochemical, Newtonian-based physical reality that is typically taught and branches into deeper realms and the science of more esoteric concepts such as energy, quantum biology, EMFs, and multidimensionality.

The heart and the innate intuitive intelligence can use epigenetic mechanisms as energetic gateways to amplify life experiences. Thoughts and emotions have a significant impact on signal behavior and quality. When we embrace the concepts of subatomic particles and endogenous EMFs, we realize the impressive effect possible on the expression of the inherent genetic blueprint.

Finally, health and wellbeing are not only an expression of the ability to heal within the conceptual framework of multiple energetic systems but are also both a reflection and an influence on the surrounding environment.

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References

1. Steinhoff U, Schnabel A, Burghoff M, et al. Spatial distribution of cardiac magnetic vector fields acquired from 3120 SQUID positions. *Neurol Clin Neurophysiol*. 2004;2004:59.

2. Baule G, McFee R. Detection of the magnetic field of the heart. *Am Heart J*. 1963;66(7):95-96. https://doi.org/10.1016/0002-8703(63)90075-9

3. Reeves-Oppenheim R. The effects of bio-intrinsic transformational therapy on depression and anxiety in adolescents. HeartMath Institute website. https://tinyurl.com/Reevespaper. Published July 15, 2021. Accessed June 18, 2022.

4. McCraty R. *Science of the Heart: Exploring the Role of the Heart in Human Performance Vol 2*. Institute of HeartMath; 2015

5. McCraty R, Zayas MA. Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. *Front Psychol*. 2014;5(Sept):1090. https://doi.org/10.3389/fpsyg.2014.01090

6. Marais A, Adams B, Ringsmuth AK, et al. The future of quantum biology. *J R Soc Interface*. 2018;15(148):20180640. https://doi.org/10.1098/rsif.2018.0640

7. McFadden JJ, Al-Khalili J. *Life on the Edge- The Coming of Age of Quantum Biology*. Broadway Books;2014.

8. McCraty R, Atkinson M, Tiller WA, Rein G, Watkins AD. The effects of emotions on short-term power spectrum analysis of heart rate variability [*published correction appears in Am J Cardiol* 1996;77(4):330]. *Am J Cardiol*. 1995;76(14):1089-1093. https://doi.org/10.1016/S0002-9149(99)80309-9

9. Armour JA. *Neurocardiology-anatomical and functional principles*. Institute of HeartMath. 2003:pub No.03-011.

10. Armour JA. Anatomy and function of the intrathoracic neurons regulating the mammalian heart. In: Zucker IH, Gilmore JP, eds. *Reflex Control of the Circulation*. CRC Press;1991:1-37.

11. Armour JA. Potential clinical relevance of the 'little brain' on the mammalian heart. *Exp Physiol*. 2008;93(2):165-76. https://doi.org/10.1113/expphysiol.2007.041178

12. Armour JA, Ardell AL, eds. *Neurocardiology*. Oxford University Press; 1994.

13. Liester MB. Personality changes following heart transplantation: the role of cellular memory. *Med Hypotheses*. 2020;135:109468. https://doi.org/10.1016/j.mehy.2019.109468

14. Pearsall P, Schwartz GER, Russek LGS. Changes in heart transplant recipients that parallel the personalities of their donors. *J Near Death Stud*. 2002;20(3):191-206. https://doi.org/10.1023/A:1013009425905

15. Beauchaine T. Vagal tone, development, and Gray's motivational theory: toward an integrated model of autonomic nervous system functioning in psychopathology. *Dev Psychopathol*. 2001;13(2):183-214. https://doi.org/10.1017/S0954579401002012

16. Kukanova B, Mravec B. Complex intracardiac nervous system. *Bratisl Lek Listy*. 2006;107(3):45-51.

17. Armour JA, Peripheral autonomic neuronal interactions in cardiac regulation. In: Armour JA, Ardell JL, eds. *Neurocardiology*. Oxford University Press; 1994:219-244.

18. Beaumont E, Salavatian S, Southerland EM, et al. Network interactions within the canine intrinsic cardiac nervous system: implications for reflex control of regional cardiac function. *J Physiol*. 2013;591(18):4515-4533. https://doi.org/10.1113/jphysiol.2013.259382

19. Lane RD, Reiman EM, Ahem GL, et al. Activity in medial prefrontal cortex correlates with vagal component of heart rate variability during emotion. *Brain Cogn*. 2001;47:97-100.

20. McCraty R, Atkinson M, Bradley RT. Electrophysiological evidence of intuition: part 2. A system-wide process? *J Altern Complement Med*. 2004;10(2):325-36. https://doi.org/10.1089/107555304323062310

21. Svensson TH, Thorén P. Brain noradrenergic neurons in the locus coeruleus: inhibition by blood volume load through vagal afferents. *Brain Res*. 1979;172(1):174-178. https://doi.org/10.1016/0006-8993(79)90908-9

22. Montoya P, Schandry R, Müller A. Heartbeat evoked potentials (HEP): topography and influence of cardiac awareness and focus of attention. *Electroencephalogr Clin Neurophysiol*. 1993;88(3):163-172. https://doi.org/10.1016/0168-5597(93)90001-6

23. Zhang JX, Harper RM, Frysinger RC. Respiratory modulation of neuronal discharge in the central nucleus of the amygdala during sleep and waking states. *Exp Neurol*. 1986;91:193-207. https://doi.org/10.1016/0014-4886(86)90037-3

24. Cantin M, Genest J. The heart as an endocrine gland. *Pharmacol Res Commun*. 1988;20(suppl 3):1-22. https://doi.org/10.1016/S0031-6989(88)80103-6

25. McCraty R. Heart brain neurodynamics: The making of emotions. In: Dahlitz M, Hall G, eds. *Issues of the Heart: The Neuropsychotherapist special issue*. Dahlitz Media;2015:76-110

26. Butler GC, Senn BL, Floras JS. Influence of atrial natriuretic factor on heart rate variability in normal men. *Am J Physiol*. 1994;267(2 Pt2):H500-505.

27. Huang M, Friend DS, Sunday ME, et al. Identification of novel catecholamine-containing cells not associated with sympathetic neurons cardiac muscle. *Circulation*. 1995;92(8):1-59.

28. Gutkowska J, Jankowski M, Mukaddam-Daher S, McCann SM. Oxytocin is a cardiovascular hormone. *Braz J Med Biol Research*. 2000;33(6):625-633. https://doi.org/10.1590/S0100-879X2000000600003

29. Marshall-Pescini S, Schaebs FS, Gaugg A, Meinert A, Deschner T, Range F. The role of oxytocin in the dog-owner relationship. *Animals (Basel)*. 2019;9(10):792. https://doi.org/10.3390/ani9100792

30. Nestor J. *Breathe, The New Science of a Lost Art*. Riverhead Books; 2020.

31. Shaffer F, McCraty R, Zerr CL. A healthy heart is not a metronome: an integrative review of the heart's anatomy and heart rate variability. *Front Psychol*. 2014;5:1040. https://doi.org/10.3389/fpsyg.2014.01040

32. McCraty R, Shaffer F. Heart rate variability: new perspectives on physiological mechanisms, assessment of self-regulatory capacity, and health risk. *Glob Adv Health Med*. 2015;4(1):46-61. https://doi.org/10.7453/gahmj.2014.073

33. Singer DH, Martin GJ, Magid N, et al. Low heart rate variability and sudden cardiac death. *J Electrocardiol*. 1988;21(suppl):S46-S55. https://doi.org/10.1016/0022-0736(88)90055-6

34. Dekker JM, Schouten EG, Klootwijk P, Pool J, Swenne CA, Kromhout D . Heart rate variability from short electrocardiographic recordings predicts mortality from all causes in middle-aged and elderly men. The Zutphen Study. *Am J Epidemiol*. 1997;145(10):899-908. https://doi.org/10.1093/oxfordjournals.aje.a009049

35. Tsuji H, Venditti FJ Jr, Manders ES, et al. Reduced heart rate variability and mortality risk in an elderly cohort. The Framingham Heart Study. *Circulation*. 1994;90(2):878-883. https://doi.org/10.1161/01.CIR.90.2.878

36. Berntson GG, Norman GJ, Hawkley LC, Cacioppo JT. Cardiac autonomic balance versus cardiac regulatory capacity. *Psychophysiology*. 2008;45(4):643-52. https://doi.org/10.1111/j.1469-8986.2008.00652.x

37. Svensson TH, Thorén P. Brain noradrenergic neurons in the locus coeruleus: inhibition by blood volume load through vagal afferents. *Brain Res*. 1979;172(1):174-178. https://doi.org/10.1016/0006-8993(79)90908-9

38. Byrne M. Vagus nerve. Kenhub website. https://www.kenhub.com/en/library/anatomy/the-vagus-nerve. Published June 7, 2022. Accessed June 17, 2022.

39. Cameron OG. *Visceral Sensory Neuroscience: Interoception*. Oxford University Press; 2002:7.

40. Bigger JT Jr, Fleiss JL, Steinman RC, Rolnitzky LM, Kleiger RE, Rottman JN. Frequency domain measures of heart period variability and mortality after myocardial infarction. *Circulation*. 1992;85(1):164-171. https://doi.org/10.1161/01.CIR.85.1.164

41. Goleman D. *Emotional Intelligence*. Bantam Books; 1995:3-29.

42. Tiller WA, McCraty R, Atkinson M. Cardiac coherence: a new, noninvasive measure of autonomic nervous system order. *Altern Ther Health Med*. 1996;2(1):52-65.

43. McCraty R, Atkinson M. Resilience training program reduces physiological and psychological stress in police officers. *Glob Adv Health Med*. 2012;1(5):44-66. https://doi.org/10.7453/gahmj.2012.1.5.013

44. McCraty R, Barrios-Choplin B, Rozman D, Atkinson M, Watkins AD. The impact of a new emotional self-management program on stress, emotions, heart rate variability, DHEA and cortisol. *Integr Physiol Behav Sci*. 1998;33(2):151-170. https://doi.org/10.1007/BF02688660

45. Alabdulgader AA. Space and human consciousness: the great whisper. *Nat Sci*. 2021;13(7):235-253. https://doi.org/10.4236/ns.2021.137020

46. Pert CB, Ruff MR, Weber RJ, Herkenham M. Neuropeptides and their receptors: a psychosomatic network. *J Immunol*. 1985;135(2)(suppl):820s-826s.

47. Pert C. Wisdom of the receptors: neuropeptides, emotions and the body-mind. candacepert.com. https://tinyurl.com/Pertwisdom. Published January 12, 2019. Accessed June 10, 2020.

48. Pert C. *Molecules of Emotion: The Science behind Mind Body Medicine*. Scribner; 1997:130-150.

49. Hammerschlag R, Levin M, McCraty R, et al. Biofield physiology: a framework for an emerging discipline. *Glob Adv Health Med*. 2015;4(1_suppl)(suppl):35-41. https://doi.org/10.7453/gahmj.2015.015.suppl

50. Pribram KH. *Brain and Perception: Holonomy and Structure in Figural Processing*. Lawrence Erlbaum Associates,Publishers; 1991.

51. Pribram KH, Melges FT. Psychophysiological basis of emotion. In: Vinken PJ, Bruyn GW, eds. *Handbook of Clinical Neurology*. North Holland Publishing Company;1969:3-316.

52. McCraty R, Atkinson M, Tomasino D. Modulation of DNA conformation by heart-focused intention. HeartMath Research Center, Publishers; 2003:1-6.

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