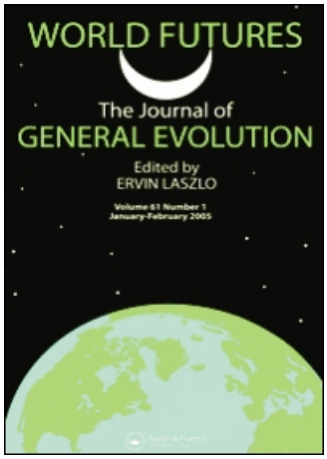

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THE PSYCHOPHYSIOLOGY OF INTUITION: A QUANTUM-HOLOGRAPHIC THEORY OF NONLOCAL COMMUNICATION

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This work seeks to explain intuitive perception—those perceptions that are *not* based on reason or logic or on memories or extrapolations from the past, but are based, instead, on accurate foreknowledge of the future. Often such intuitive foreknowledge involves perception of implicit information about nonlocal objects and/or events by the body's psychophysiological systems. Recent experiments have shown that intuitive perception of a future event is related to the degree of emotional significance of that event, and a new study shows that *both* the brain and the heart are involved in processing a pre-stimulus emotional response to the future event. Drawing on this research and on the principles of quantum holography, I develop a theory of intuition that views the perception of things remote in space or ahead in time (nonlocal communication) as involving processes of energetic resonance connecting the body's psychophysiological systems to the quantum level. The theory explains how focused emotional attention directed to the nonlocal object of interest attunes the bio-emotional energy generated by the body's psychophysiological systems to a domain of quantum-holographical information, which contains implicit information about the object. The body's perception of such implicit information about things distant in space/time is experienced as an intuition.

KEYWORDS: Bio-emotional energy, communication, intuition, precognition, presentiment, psychophysiology, nonlocality, quantum holography.

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> The entire universe is one unique, immense sound from which burst, like a ripe pomegranate, billions of harmonics, all composing one same oceanic harmony. (Rolland, 1956, p. 23)[1]

INTRODUCTION

This work seeks to explain intuitive perception—those perceptions that are *not* based on reason or logic or on memories or extrapolations from the past, but are based, instead, on accurate foreknowledge of the future. A recent study (McCraty et al., 2004a, 2004b) defined such foreknowledge of a future event as intuition, and viewed intuition as a process by which information normally outside of the range of conscious awareness is immediately sensed and perceived by the body's psychophysiological systems.

The objective of this work is to demystify intuition by building a rational account firmly grounded in recent empirical evidence, whose reason and logic is informed by established scientific principles and concepts and is amenable to empirical verification. Toward this end, recent work on the psychophysiology of intuitive perception and the principles of quantum holography are used to develop a theory of intuitive perception. The theory explains how implicit information about a future event can be accessed by the body's psychophysiological systems as intuitive information.

To adequately address the question at issue here—accurate foreknowledge of the future—requires drawing on the concept of nonlocality from quantum physics. Nonlocality is the fundamental interconnection of everything at the quantum level such that faster-than-the-speed-of-light communication/interaction is implied between subatomic particles separated in space/time by vast distances. However, because such interaction defied Einstein's concept of a "cosmological constant"—the speed of light—nonlocality was derided by him as "spooky action at a distance." Yet nonlocality is a peculiarity of quantum theory that has been empirically demonstrated in repeated laboratory experiments (e.g., Aspect et al., 1982; Tittel et al., 1998), and is thus a scientific fact that I build on in this work.

The perception of information from nonlocal sources is a phenomenon that has been studied and well documented in a large volume of rigorous scientific experiments for more than a century.[2] The consistent finding from these experiments is that such intuitive foreknowledge involves perception of implicit information about nonlocal objects and events by the body's psychophysiological systems. A review of this research suggests that such intuitive ability is unlikely to be specific to any subpopulation, but rather appears to be an ability generally distributed throughout the human population. I draw on the findings of this research, and, in particular, on a recent significant study (McCraty et al., 2004a, 2004b). The latter is notable because it not only presents compelling evidence of intuitive foreknowledge, but also, and more importantly for my purposes here, it shows *where* and *when* in the body intuitive information is received, and *how* this information is processed.

Drawing on Nobel Laureate Denis Gabor's (1946) energy-based concept of information—the encoding of information as a pattern of oscillations in energy at *any* frequency—the theory explains how information about nonlocal objects and

events is spectrally enfolded at the quantum level in the radiation of energy. Such implicit information about the future is distributed as a hologram throughout a field of potential energy that exists as a domain apart from space and time. At a biological level, the body's psychophysiological systems generate numerous fields of energy, at various frequencies, that radiate outwards and interpenetrate the field of potential energy.

The act of perception generates an outgoing wave field of attentional emotional energy directed to an object of interest that interacts with an incoming wave field of energy from the object. Focused emotional attention directed to the object of interest attunes the psychophysiological systems to the quantum level of the object, which contains holographically encoded information about the object's future potential. Such emotional attunement—*coherence*—brings the outgoing wave field of attentional energy from the individual's psychophysiological systems into harmonic resonance with the incoming wave field of energy from the object. The harmonic resonance between the two wave fields of energy creates an optimal channel for communication of nonlocal information. The body's perception of such implicit information about the object's future is experienced as an intuition. The theory leads to the following hypothesis: the more coherent the emotional attentional interest directed to the object of interest, the greater the body's psychophysiological system's access to the field of quantum-holographic nonlocal information, and, hence, the greater the intuitive foreknowledge about the object of interest.

CONCEPT OF INTUITION

Taking an information processing perspective, intuition is viewed as a process by which information normally outside the range of cognitive processes is sensed and perceived in the body and mind as certainty of knowledge or feeling (positive or negative) about the totality of a thing distant or yet to happen (McCraty et al., 2004a, 2004b). This "thing" can be a material object or event, or a mental construct such as a thought or idea. Often the feeling of certainty is immediate and absolute—the intuition is experienced as beyond question or doubt—and the feeling can encompass positive emotions, such as optimism and excitement, or negative emotions like dread, fear, or terror.

This experience of an immediate, total sense of the thing as a whole is quite unlike the informational processing experience of normal awareness. In normal awareness, the contents of the brain are updated incrementally, as the moment-by-moment sequences of sensory experience unfold. Also, the experience of intuition is not confined to cognitive perception, but involves the *entire* psychophysiological system, often manifesting through a wide range of emotional feelings and physiological changes experienced throughout the body. Indeed, it is this involvement of the entire psychophysiological system in processing intuitive perception that has enabled its detection and measurement using electrophysiological instrumentation, as described in the research reviewed in the next section.

The results of these studies question a commonly held view of intuition: namely, that it is not registered by the five senses of normal perception (vision,

audition, taste, smell, and touch), but, instead, is either a direct, unmediated interaction between the brain and a nonlocal source, or is the result of some subtle, extraordinary—even supernatural—sense or force that conveys accurate nonlocal information straight into the brain (Bernstein, 2005).[3] Yet the interesting news from this research is *not* that of discovery of a new sixth sense or of a new information pathway to nonlocal things. Rather, it is that known physiological structures are involved (*both* the brain and the heart), and that the body appears to process intuitive information in the *same* way it processes information from ordinary sensory input.

SCIENTIFIC EVIDENCE

Although there is now a voluminous body of rigorous experimental research documenting the phenomenon of intuitive perception (see Radin's informative review, 1997a), mainstream science still regards the findings of these studies as anomalous (Walach and Schmidt, 2005).[4] Even among those who study it, intuition is viewed largely as the result of past experience—a function of the unconscious mind accessing existing information within the brain from forgotten experience (Agor, 1984; Eisenhardt and Zbaracki, 1992; Hogarth, 2001; Laughlin, 1997; Lieberman, 2000; Myers, 2002). In presenting a very brief review of the evidence from studies that challenge this view, I will follow Bernstein (2005) and divide the work on the basis of the kind of intuitive information communication investigated: *person-to-person* communication, often referred to as telepathy; *place-* or *object-to-person* communication, also known as extra-sensory perception (ESP) or remote viewing; and *future-to-person* communication, involving precognitive perception (thoughts) or presentiment perception (emotions).

Prior Research

In the 1930s Joseph Rhine (1964, 1981) conducted numerous pioneering studies on telepathic *person-to-person* information communication. He developed a "forced choice" card test using a special deck of twenty-five cards comprised of five groups of five geometric symbols (triangle, square, circle, star, wavy lines). In 27 of 33 laboratory experiments, involving almost one million trials, he found statistically significant results in which a "receiver" correctly identified the symbol mentally transmitted by a "sender," in a different room, from a randomly selected card. Replication studies at other laboratories yielded a 61% statistically significant success rate, compared to 5% expected by chance. In the 1960s, Charles Tart (1963) added physiological instrumentation to measure the receiver's bodily response when a stimulus was administered to the body of a "sender," who was located in a separate room. He found that the receiver's brain waves and peripheral blood volume changed significantly when the stimulus was applied near to or on the sender's body. A meta-analysis (Schlitz and Braude, 1997) of 19 laboratory studies conducted in Scotland and California in the 1980s and 1990s, involving "healers" sending their thoughts on a randomized schedule to receivers, found statistically significant changes in the receivers' bodies using Galvanic Skin Response (GSR) measures when the senders' thoughts were focused on them. Another 40

studies, conducted during this time, employed a Ganzfield procedure (to isolate the receivers from normal visual and auditory stimuli) and Faraday cages and steel wall screening (to block electromagnetic radiation), and found that the receivers' overall accuracy rate in correctly identifying which of four images had been sent by a sender, exceeded the rate expected by chance by a factor of 10^{15} to 1 (Radin, 1997a, pp. 87–88).

Rhine (1964, 1981) was also a pioneer in research on *place-to-person* information communication, in which a receiver is to identify a randomly selected distant target, also unknown to the experimenter. In the 1930s he conducted 34 studies involving 792,000 trials, and found success rates above those expected by chance. Using the remote viewing protocol they developed in the 1970s (Puthoff and Targ, 1976), scientists at the Stanford Research Institute collaborated with the CIA to conduct a series of follow-up studies in the 1980s and 1990s (May et al., 1988; Puthoff, 1996; Targ, 1994). Involving more than 1,000 trials, the results from these studies found that the accuracy rates of the receivers' descriptions of the remote targets (scored by an independent panel of judges) exceeded chance by a factor of 10^{20} to 1.

Turning to the work on *future-to-person* information communication, Honorton and Ferrari (1989) conducted a meta-analysis of the 309 studies (published in English) conducted on precognition between 1935 and 1989. All of the studies were laboratory controlled experiments in which subjects had to predict a target that would be selected in the future by a randomized procedure. Conducted by 62 different researchers and involving more than 50,000 subjects in nearly 2 million trials, the accuracy rate of correct predictions exceeded chance by 10^{25} to 1.

A number of recent studies examining the brain's pre-stimulus response have demonstrated significant differences in event-related potentials[5] before target presentation as compared to non-target stimuli during forced-choice precognition tasks (Warren et al., 1992a, 1992b). Don et al. extended these ERP findings in a series of gambling studies in which they found enhanced negativity in the ERP's was widely distributed across the scalp in response to future targets (Don et al., 1998; McDonough et al., 2002). The authors concluded from these studies that the ERP effect was an indicator of "unconscious precognition," because the study participants' overt guessing accuracy did not differ from chance expectations.

Before moving on, I want emphasize the scientific significance of this voluminous body of evidence. As Radin (1997a) concludes, from meta-analyses of the results of the experiments on each of the three kinds of intuitive perception briefly reviewed here, *the likelihood that an intuitive effect is true exceeds the certainty of measurement in experiments verifying quantum mechanics—the most accurate scientific description of reality* (see Penrose, 1989 or Nadeau and Kafatos, 1999).

In the last decade, researchers have turned their attention to presentiment and have begun to explore physiological predictors of future events by investigating whether the human autonomic nervous system can unconsciously respond to randomly selected future emotional stimuli. Radin (1997a, 1997b, 2004) designed elegant experiments to evoke an emotional response using randomly selected emotionally arousing or calming photographs, with measures of skin conductance level (SCL) and photoplethysmographic measures of heart rate and blood

volume. Comparison of SCL response between emotional and calm trials showed a significantly greater change in electrodermal activity around 5 seconds before a future emotional picture than before a future calm picture. These results have since been replicated (Bem, 2003; Bierman, 2000; Bierman and Radin, 1997; Bierman and Scholte, 2002; Radin, 2004), and a follow-up study, using functional magnetic resonance imaging, found brain activation in regions near the amygdala (which handles the processing of strong emotions such as fear and rage) *before* emotional pictures were shown, but not before the calm pictures (Bierman and Scholte, 2002). The consistent finding across these studies is that the *body typically responds to a future emotionally arousing stimulus four to seven seconds prior to experiencing the stimulus*.

Evidence of the Heart's Involvement

A surprising result from a recent study conducted by the Institute of HeartMath suggests that the heart is directly involved in receiving and processing intuitive information about a future event (McCraty et al., 2004a, 2004b). We used Radin's (1997b, 2004) basic experimental protocol (see Figure 1) while including additional electrophysiological measures of brain and heart activity well suited to investigate information processing. Drawing on the presentiment findings, we postulated that the greater the emotional significance of a future stimulus, the larger the physiological response prior to experiencing the stimulus. And because prior research has shown that the pattern of the rhythm of heart activity directly reflects the processing of emotional experience in the body (McCraty and Childre, 2004; Tiller et al., 1996), we suspected that the heart played a role in processing pre-stimulus information about a future event.

The study used a counterbalanced crossover design in which 30 calm (pleasant or neutral) and 15 emotionally arousing (violent or erotic) pictures were randomly presented to 26 participants in two sessions, two weeks apart, under two experimental conditions: a baseline condition of "normal" psychophysiological function

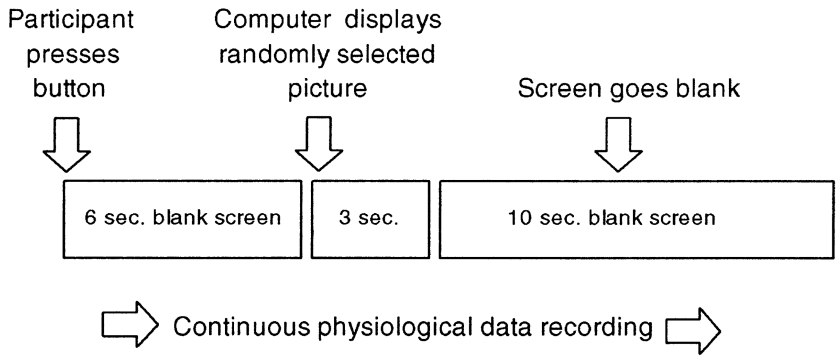

Figure 1. Experimental protocol for electrophysiological study of intuitive perception (from McCraty et al. 2004a, 2004b).

and a condition of psychophysiological coherence—a distinctive, highly efficient mode of psychophysiological function induced by a heart-focused, positive emotional state (see McCraty and Childre, 2002; McCraty et al., 2006).

The second condition was included because we expected that a calm, coherent emotional state enhanced the body's response to pre-stimulus information about a future event.[6] For each trial in the experiment the subject pressed a button on a computer keyboard and, after a 6-second blank screen interval, the computer displayed a randomly selected picture for 3 seconds, which was followed by 10 seconds of a blank screen, as shown in Figure 1. Throughout each experimental session continuous electrophysiological measurement of the subject's body response was recorded. Primary measures included: skin conductance; the electroencephalocardiogram (EEG), from which cortical event-related potentials (ERP) and heartbeat-evoked potentials (HBEP) were derived; and electrocardiogram (ECG), from which cardiac decelerations/accelerations were derived. These measures were used to investigate where and when in the brain and body intuitive information is processed. Data from 2,340 trials were collected across the two sessions for all subjects and subjected to statistical analysis.

There were a number of significant findings from our study. The first is the surprising result that the *heart* receives informational input regarding the future emotional stimulus. As shown in Figure 2, this is where the slope of the heart rate deceleration curve for the emotional trials clearly starts to diverge from the slope for the calm trials. Based on classical psychophysiological interpretations of cardiac decelerations/accelerations in relation to the processing of sensory information, these data suggest that the heart responds to the unknown stimulus in the *same* way it does when the future stimulus is known. A second finding, also shown in Figure 2, is that there were significant differences in brain response (primarily in the frontal areas) in the cortical event-related potentials, marked by increased negativity and a faster onset of the positive-going wave in the emotional trials. A third finding of particular importance, should it be confirmed in subsequent studies, is that the heart appears to receive intuitive information even *before* the brain (~4.8 seconds before the stimulus versus ~3.5 seconds, respectively); this is also evident in Figure 2 when one compares the divergence of the heart rate variability (HRV) and ERP curves in the pre-stimulus period for the emotional trials. A fourth finding is that the frontal cortex, left temporal areas, occipital areas, and, to a lesser degree, parietal areas of the brain appear to be involved in the processing of intuitive information. A fifth finding is that there were significant differences in heartbeat-evoked potentials between the calm and emotional trials, primarily in Condition 2, the psychophysiological coherence state. And finally, there were significant gender differences in the processing of pre-stimulus information.

Especially noteworthy was evidence of an apparent interaction between the HBEPs and ERPs in the females during the emotional trials. This suggests that afferent (ascending) input from the heart to the brain contains information pertaining to the future stimulus, and also that females may be more attuned to information from the heart. Overall, these findings suggest that intuitive perception is not a discrete function produced by a single part or system of the body alone—the brain—as previously thought. Rather, it appears that intuition is a system-wide

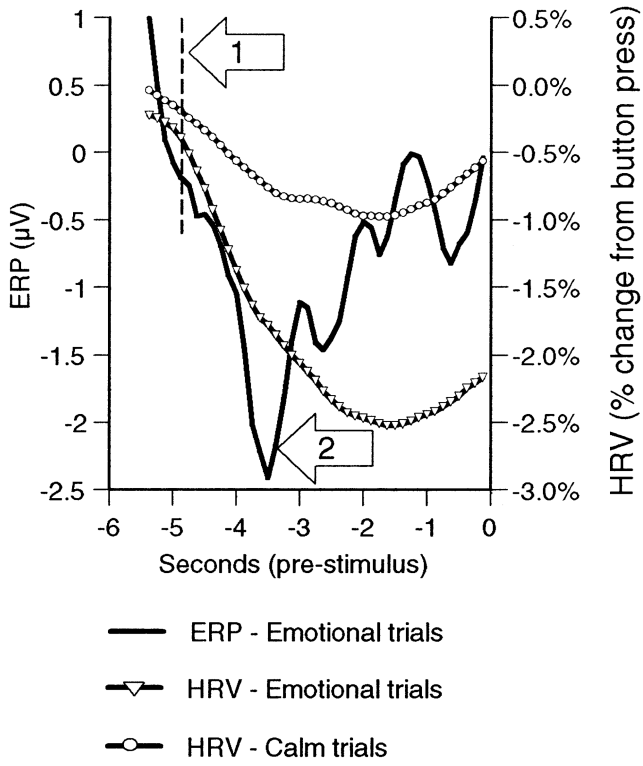

Figure 2. Temporal dynamics of heart and brain pre-stimulus responses. This overlay plot shows the mean event-related potential (ERP) at FP2 and heart rate deceleration curves for the female subgroup ($n = 15$) in Condition 1 during the pre-stimulus period. (The "0" time point denotes stimulus onset.) The heart rate deceleration curve for the emotional trials diverged from that of the calm trials (sharp downward shift) about 4.8 seconds prior to the stimulus (arrow 1), whereas the emotional trial ERP showed a sharp positive shift about 3.5 seconds prior to the stimulus (arrow 2). This positive shift in the ERP indicates when the brain "knew" the nature of the future stimulus. The time difference between these two events suggests that the heart received the intuitive information about 1.3 seconds before the brain (from McCraty, Atkinson, and Bradley, 2004b).

process involving at least the heart *and* brain (and possibly other body systems), *together*, in the processing and decoding of intuitive information (McCraty et al., 2004a, 2004b, 2004–2005).

Evidence of Collective Intuition

Before moving to the task of explanation, I want to present one further piece of evidence of intuitive foreknowledge, only this time at the collective level. This comes from data from the output from Random Number Generators (RNGs) in the

hours before the terrorist attacks took place in the United States on the morning of 11 September 2001 (Nelson, 2002; Radin, 2002). As we will see in a moment, these data suggest that there was *implicit global foreknowledge of the impending terrorist attacks some three to four hours* **before** *the first plane crashed into the North Tower* of the World Trade Center at 8:45 a.m.

Initiated in 1998 by Roger Nelson (2001), the Internet-based Global Consciousness Project (GCP) has been collecting the random data that is continuously generated by RNGs in more than 40 sites throughout the world. The collected data are analyzed to determine if there is a correlation between global events of mass consciousness and periods of non-random order generated by the RNGs.[7] In Nelson's words:

> Our research hypothesis predicts the appearance of increasing coherence and structure, or non-random trends, in the globally distributed data collected during major events in the world. The events . . . share a common feature, namely, that they powerfully engage human attention all around the world, and draw us in large numbers into a common focus. (Nelson, 2002, pp. 550–551)

This hypothesis appears to be strongly confirmed by the results of an analysis of 104 global events, investigated as of May, 2002, which had a combined overall significance of $p < 3 \times 10^{-7}$(Radin, 2002).

In independent analyses of the outputs of the RNGs, Nelson (2002) and Radin (2002) found that the largest departure from random order in the year 2001 occurred on 11 September 2001, and that this anomalous structure could not be explained by artifacts such as electrical disturbances or high levels of mobile phone use. This can be seen in the plot of data in Figure 3 which shows a significant rise in the curve for the cumulative deviation for the 11 September data when compared to plots of data for the ten days surrounding 11 September—the 5th through the 15th.[8] Radin (2002) reports that virtually every analysis he conducted of the 11 September data revealed anomalous statistical order in the RNG output on that day. For instance, he found that the largest daily change in variance in a whole year of daily observations occurred on 11 September, and in calculating the correlations among all possible pairs of RNG outputs on a per-day basis, he found that the largest daily average correlation also occurred on 11 September.

Even more intriguing is that Nelson and Radin also found evidence of global precognition in the RNG output data prior to the attacks. This can be seen in the comparison of the pattern for the "true data" with that for "pseudo data" in Figure 4, in which the former are the cumulative deviation of variance across the RNGs for each second on 11 September.[9] Compared with the empirical control, the pattern for the true data is that of random fluctuation until about *three or four hours before the attacks*, at which point there is a steep, persistent rise, peaking during the period of the attacks, and then an equally strong, persistent decline some four hours or so later in the day. This is also apparent from an analysis of the odds against chance, calculated from 6 September through 13 September 2001, which showed a large spike in the pattern on 11 September. In commenting on the results, Nelson notes that "in terms of the original, unsmoothed data, the spike incorporates

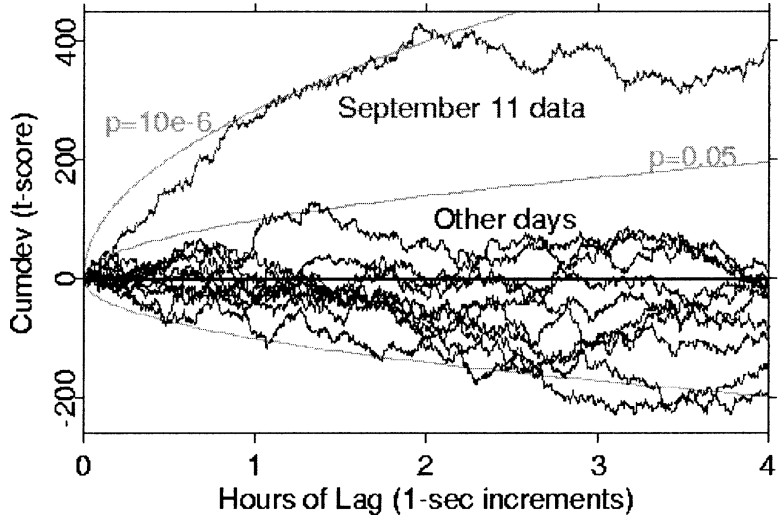

Figure 3. Cumulative sum of normalized autocorrelation coefficients for the second-by-second inter-egg (RNG) variance measure, calculated for all lags up to 4 hours. The time period is the 24-hour UTC day of 11 September. The smooth curves show a 0.0005 threshold and the ±5% probability envelope (from Nelson, 2002, Figure 5).

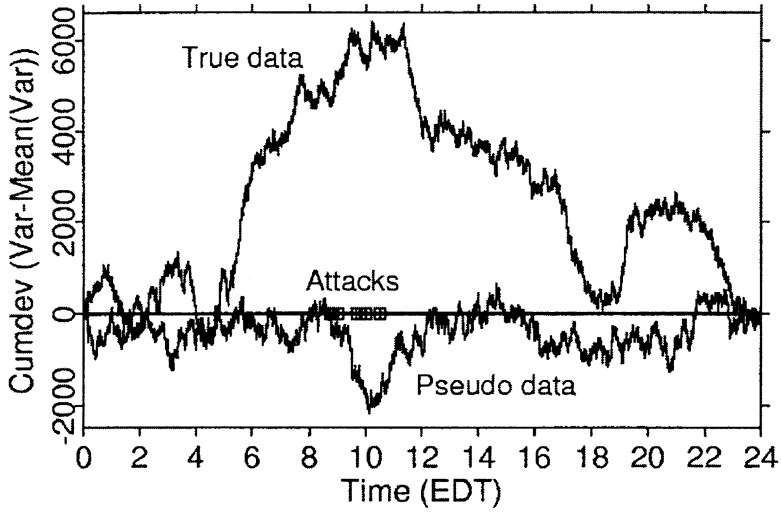

Figure 4. Cumulative deviation of variance across eggs (RNGS) for each second on 11 September 2001. Times of the separate events in the terrorist attacks are marked with rectangles on the zero line. The light gray curve labeled "Pseudo Data" shows a control calculation using a pseudo-random clone data set for each day (From Nelson, 2002, Figure 3).

some large deviations (from chance) early in the morning, and the peak weight of the moving average actually centers at 6:30, somewhat *more than two hours prior to the first WTC hit*" (Nelson, 2002, p. 560; my addition in parentheses and my italics).

However, although a number of independent analyses of the RNG data find the same pattern of anomalous order on 11 September 2001, briefly described here,[10] virtually all of the researchers involved are puzzled by the following perplexing observation: Why was the event effect of 11 September 2001 weaker than that of the effect measured in prior Global Consciousness Project events—especially when the attacks on 11 September 2001 produced mass horror and anxiety all around the world unmatched in the prior events? This paradox is resolved when the explanation is broadened from a focus on the mental attention of the brain (e.g., Jahn, 2001; Jahn and Dunne, 2001; Nelson, 2002) to include the heart and the bio-emotional energy generated by the body as a whole. As will become clear in the theory that follows, I believe the explanation has to do with the difference in the resonance potential of coherent and incoherent wave fields of positive and negative bio-emotional energy, respectively. Generated by the body in processing precognitive energetic information about impending future beneficial or harmful events, these wave fields of attentional bio-emotional energy are amplified when social aggregations focus on a common event that tunes them into a resonant frequency.

Empirical Generalizations

On the basis of this brief review of the research on intuition, we can derive the following empirical inferences that an adequate theory of intuition must explain:

- the experiments on telepathy, involving Faraday Cages and steel wall shielding, show that electromagnetism cannot be the "carrier wave" for the transmission of intuitive information between persons;
- the remote viewing experiments show that the transmission of intuitive information does not decrease over distance and is not affected by location;
- the experiments on precognition and presentiment show that intuitive foreknowledge about a future event is not limited by the normal causal relations of time;
- the recent experiments on presentiment show that intuitive perception is related to the degree of emotionality of a nonlocal object or event;
- subject to confirmation by future studies, the results from our own study suggest that both the heart and the brain (and possibly other bodily systems) are involved in intuitive perception of future events;
- the results from electrophysiological studies show that intuitive information appears to be processed by the body in the same way as information from normal sensory input; and
- that the results from studies of the RNG output in the hours immediately prior to the terrorist attacks on September 11, 2001, suggest that implicit global foreknowledge of future events of mass common significance (collective intuition) is recorded in the bio-emotional energy wave field of the human population.

THEORY

For mainstream science, intuition—the body's ability to receive and process information about things distant or in the future—is, at best, an empirical anomaly that belongs to a class of phenomena that has been especially perplexing and difficult to come to grips with, let alone explain (Walach and Schmidt, 2005). This is the phenomenon of *action at a distance*, which is nowadays referred to as *nonlocality*. In reflecting, over four hundred years ago, upon the difficulty posed by gravitational force, Newton summed up the quandary of action at a distance in a letter to Bentley, his closest friend:

> It is inconceivable that inanimate brute matter should, without the mediation of something else which is not material, operate on and affect other matter without mutual contact. . . . That one body may act upon another at a distance and through a vacuum without the mediation of anything else by and through which their action or force may be conveyed from one to another is to me so great an absurdity that I believe no man who has in philosophical matters any competent faculty of thinking can ever fall into. (Newton, in Turnbull, 1961, p. 253f)

Yet modern science has found that the capacity to receive and process information about nonlocal events appears to be a fundamental property of all physical and biological organization, and is likely due to the inherent interconnectedness and non-separability of everything in the universe at the quantum level (Bohm and Hiley, 1993; Laszlo, 1995; Nadeau and Kafatos, 1999; Bekenstein, 2003).

This property of universal interconnectedness, also known as quantum entanglement, was dramatically demonstrated in experimental violations of Bell's theorem of inequality in the 1980s and 1990s. These experiments showed that it was impossible to break the connection between a pair of entangled sub-atomic particles even when each particle was separated by enormous micro-scale distances; initially over meters (Aspect et al., 1982) and subsequently over kilometers (Tittel et al., 1998). When the experimental condition was applied to one member of the experimentally separated entangled photon pair, the other member simultaneously changed its behavior at the same instant. In the words of Alain Aspect, "We must conclude that an entangled EPR [Einstein, Podolsky and Rosen] photon pair is a non-separable object; that is, it is impossible to assign individual local properties (local physical reality) to each photon. *In some sense, both photons keep in contact through space and time*" (Aspect, 1999, p. 190; addition in square brackets and emphasis in italics, mine).

At the molecular level, all matter absorbs and reemits quanta of energy from and into an underlying field of quantum fluctuations called *zero point energy*. Instead of being random fluctuations, the emissions from complex matter exhibit quantum coherence reflective of the matter's material organization; these emissions also carry information nonlocally about the event history of the matter's quantum states. This suggests that all biomatter at all scales of organization is informationally interconnected, endogenously, by nonlocal quantum coherence, and also exogenously connected to the larger external environment by the biomatter's coherent quantum emissions (Mitchell, 2004, p. 155). Thus, in seeking to explain how human intuition occurs, recent theories have endeavored

to build on this understanding and have used the concept of *nonlocal quantum interconnectedness* as a physical means or medium for communication of intuitive information.

Broadly speaking, there have been two approaches in recent work to a build a scientific explanation for communication of intuitive information. The most common approach is based on various applications of holographic theory. The other is based on an extension to the space-time dimensionality underlying relativity theory, which will be presented first.

Zero-Point Theory of Space-Time Dimensionality

To build an explanation for the time-reversal cause and effect dynamics involved in intuitive foreknowledge, Rauscher and Targ (2001) make an extension to Relativity Theory's Einstein-Minkowski 4-dimensional space-time. By adding three extra dimensions to space and an extra dimension to time to the conventional 4-dimensional Einsteinian conception of space-time at the macro-scale, they construct a complementary micro-scale domain which establishes nonlocality as a property of this 8-dimensional universe. They use the universal connectivity of the zero-point energy field of the quantum vacuum as the mechanism for the kind of instantaneous communication involved in precognition and presentiment. They demonstrate universal connectivity by showing, mathematically, that there is always a path between any two points in this 8-dimensional space-time universe that has zero units of separation.[11] This condition of adjacency, or inseparability, means that nonlocality holds for both space *and* time, which provides a physical mechanism for communication of information about an object or event from the future. Therefore, because any two points in time can become adjacent—in effect, they are inseparably entangled or interconnected—an effective pathway of *no*-time between the two exists. This means that information transmission between the two points occurs in "no-time," so that what will happen in a future time can be known now, in present time.

Although Rauscher and Targ's extension to an 8-dimensional space-time concept of physical reality appears to be consistent with the explanatory principles of modern physics, in that it does not seem to violate the equations of Maxwell, Einstein, or Schodinger, nor the Poincare and Lorentz invariances (Bernstein, 2005), and although it appears to provide a physical means for bridging both the spatial and temporal elements of nonlocal information transmission, it only seems to explain a *part* of what intuition involves. It leaves unaddressed two basic issues: first, the question of how the body "knows" which, from the set of all possible pairs of points that connect "now" to all future points, is the "correct" pairing to the actual point in the future relevant to the situation at hand; and second, the question of the means and processes by which the body accesses and translates information from this 8-dimensional world into intuitive perception. Because holographic approaches are both used in physics to explain nonlocal interaction (Bohm and Hiley, 1993; Nadeau and Kafatos, 1999) and used in neuropsychology to explain sensory perception and memory in the brain (Pribram, 1971, 1991),[12] holographic theory offers a single explanatory framework for understanding nonlocal information

communication in both the physical and biological realms, which I believe, provides a more fruitful approach to explaining intuition.

Holographic Theory

The appeal of holographic theory (Gabor, 1948) is the explanatory power of its principle of distributed organization as the informational mechanism for nonlocal interaction—that the information about the properties and organization of a whole (object or event) is spectrally encoded into oscillations of energy as an interference pattern and radiated throughout a field of potential energy to all points and locations. Because it is possible to retrieve information about the whole from *any* location within the field, holographic theory, and its basis in the linear mathematics of the Fourier transform function, has been postulated to provide a reversible physical mechanism by which intuitive information can be encoded, transmitted, received, decoded, and perceived.[13]

To create a hologram requires two sets of waves—a set of object waves and a set of reference waves. The object wave is directed towards the object. It encodes intensity changes and phase-shifts reflecting the features of the object as the wave interacts with the object, and then is emitted away from the object in all directions.[14] When a reference wave is directed back toward the emitted object wave, it interacts with the object wave and creates an interference pattern that records the phase-shifts of the object wave relative to the reference wave; these phase-shifts produce the apparent momentary freezing of the object's 3-dimensional image in space-time. At the moment of conjunction, the instant the interference pattern is created, *both waves are spatially and temporally coherent*—an important point that I build on later. Then they continue on radiating as separate waves. In short, it is the interference pattern that encodes the phase-shift information from which a 3-dimensional image—a *holograph*—of the object can be reconstituted in space-time, via a Fourier transform function. Research on the creation of holographs in nature, has shown that bats and dolphins actually create holograms by transmitting acoustical object waves and reference waves that radiate outward into their environments and that are then reflected back to the animal for neural processing and translation into holographic images of objects in the environment (Farhat, 1980; Schueler, Lee, and Wade, 1984).

There are, however, two basic forms of holography: Classical Holography, developed to understand the physics of *image* processing (Gabor, 1948); and Quantum Holography, developed to explain the physics of *information* transmission in signal processing (Gabor, 1946). Because Classical Holography is based on an invertible linear process involving a Fourier transform function, there are *no* degrees of freedom in the transformation relations; chance and probability are not involved. This means, in effect, that Classical Holography is a principle of system organization in which constituent parts are enfolded into and whose behavior is informed and, therefore, *determined* by the global organization of the system as a whole. As a result, theories that attempt to use the principles of Classical Holography as a means for explaining intuition, such as Bohm's theory of the implicate order (Bohm, 1980; Bohm and Hiley, 1993) and Laszlo's theory

of quantum-vacuum-interaction (Laszlo, 1995), run into the inherent limitations of holographic determinism, which, by definition, rule out human choice and free will (see Bradley, 1998). However, in recent explications of his theory (e.g., Laszlo, 2003), Laszlo has adopted more of a quantum-holographic approach and has reached conclusions broadly similar to those I lay forth in this work.

Quantum holography is based on Gabor's (1946) energy-based concept of information, the *logon*, which provides the foundation for a non-determinist kind of holographic organization (Bradley and Pribram, 1998; Bradley, 2002). He defines a unit of information as *the minimum uncertainty with which a signal can be encoded as a pattern of energy oscillations across a waveband of frequencies*, as in the encoding and transmission of vocal utterances for telephonic communication.[15] Gabor was able to define the smallest area, in space and in time, within which a signal can be encoded in the oscillations of energy and still maintain fidelity for information communication (see Figure 5). He called this area a *logon*, or a *quantum* of information (hence the term *quantum holography*; see Pribram, 1991), and showed that the signal that occupies this minimum area "is the modulation product of a harmonic oscillation [of energy] of *any* frequency with a pulse in the form of a probability function" (Gabor, 1946, p. 435; my addition and emphasis). In mathematical terms, the logon is a sinusoidal module variably constrained by space-time coordinates—essentially a *space-time-constrained hologram* (see Pribram, 1991; Bradley, 1998).[16]

An important point, which bears directly on the question of determinism, is that logons are *not* discrete units but occur as a series of space-time–constrained

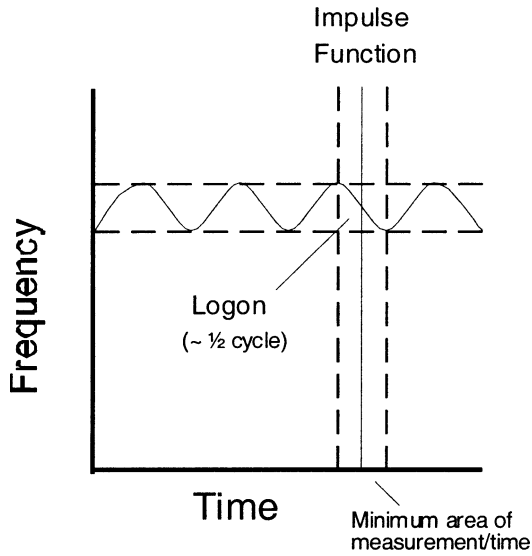

Figure 5. An idealized graph of a Hilbert Space showing a logon (Gabor elementary function) in terms of Gabor's (1946) limits of measurement (adapted from Bradley, 2002).

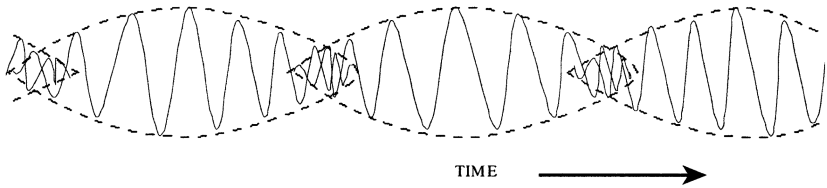

Figure 6. Representation of the overlap among logons (from Bradley and Pribram, 1998).

sinusoids, each wrapped in a Gaussian probability envelope: a series of modularized, overlapping units in which the "heads" and "tails" of adjacent units interpenetrate one another, as is illustrated in Figure 6. This overlap among logons introduces indeterminacy, in that the data in each module are spectrally enfolded, to some degree, into the data of adjoining logons. This overlap among logons has a significant implication for information communication from the future, in that each logon, in Gabor's words, contains an "*overlap [with] the future*" (Gabor, 1946, p. 437; my addition and emphasis). This means, in effect, that each unit of information, by virtue of its spectral enfoldment with adjoining units, contains information on the future order energetically encoded in the unit that succeeds it (Bradley, 1998; Bradley and Pribram, 1998).

In addition to an earlier application of the principles of quantum holography to explain the communication of endogenous order among the members in social collectives (Bradley, 1987, 1996, 2003)—including intuitive "anticipation" of future social order—on which I build later, there are two other holographic theories of intuitive perception.

Theory of Magnetic Wave Information Transmission

Developed to explain telepathic communication (transmission of intuitive information from one person to another), one of these is Tiller's theory of super-luminal magnetic carrier wave propagation (Tiller, 1999, 2004). Based on an extension of wave-particle duality, his theory proposes information transmission through a part of the zero-point energy field of the quantum vacuum, he calls R-subspace, by magneto-electric carrier waves. By moving into a more internally coherent state (as through meditation), the human brain propagates magnetic waves into R-subspace; because the magnetic waves are modulated by the information content of the sender's mind, they encode, via Fourier transform equations, this information into magnetic waveforms that radiate from the source at great speed. Thus this provides a physical means by which human intention, emotion, and other characteristics of mind are (quantum-holographically)[17] encoded and communicated through the micro-scale quantum vacuum's R-subspace at much higher speeds (up to twice the speed of light) than the information transmitted over long distances in our macro-scale 4-dimensional world by carrier waves of electromagnetism (visible light, radio, etc.) at the speed of light.

However, Tiller's theory has two disadvantages as a basis for a theory of intuition. First, his notion of information transmission via magneto-electric waves through R-subspace is a hypothesis which, as yet, is empirically unsubstantiated. And second, he restricts nonlocal information communication to a specific energy frequency—namely, that of magneto-electric carrier waves.

Theory of the Nonlocal Quantum Hologram

The other holographic theory is the theory of the nonlocal quantum hologram as the nonlocal carrier of quantum-level information for molecular and macro-scale organization, which emerges from the work of Mitchell, Marcer, and Schempp (Marcer and Schempp, 1997, 1998; Mitchell, 2000; Marcer and Mitchell, 2001). These scientists combine the information processing efficiency and storage capacity of holography with the inherent interconnectedness (or "entanglement") of objects and events at the quantum level, to create a theory to explain remote viewing (intuitive perception of objects or events over great distances).

Their theory is based on the following postulates: first, that a quantum hologram is created at the quantum level that contains nonlocal information about the specific organization of quantum reality associated with an object, entity, or event in the macro-scale world; second, that the act of perception requires both an incoming wave field of sensory information about the object *and* an outgoing wave field of attentional energy; and third, that a relationship of "*phase-conjugate-adaptive-resonance*" between the incoming wave field and the outgoing wave field is required to perceive an object in the macro-scale 4-dimensional world. Phase-conjugate-adaptive-resonance is a process in which the incoming and outgoing wave fields are phase-conjoined by the percipient's act of attention, in that s/he tunes into and maintains "vibratory resonance" with the object's energetic oscillations at the quantum level.[18] The concept was proposed by Marcer to show how *both quantum information and space-time information are involved in perception*—that the percipient and the source of information must be in a resonant relationship for sensory information to be accurately perceived:

> . . . if we consider that the condition of phase-conjugate-adaptive-resonance is necessary to completely specify the act of perception as described in the mathematical formalism of the nonlocal hologram by Marcer, then we may also consider the perceived object and the percipient's perceptual system as locked in a resonant feedback loop. The incoming wave front carrying information may be labeled as "perception" from the point of view of the percipient, and the return path required by the resonant relationship may be labeled "attention." . . . (Mitchell, 2000, p. 302)

As a wave field of any kind interacts with a physical object, parts of its amplitude and phase are altered, not only because part of the wave is reflected from the object's surface, but also because part of the wave's energy is absorbed by the object. This absorption energizes the object to emit a wave outward, part of which may travel back toward the source of the initial wave (Marcer, 2004). Based on the derivation of macro-scale images from the application of quantum holography

in Functional Magnetic Resonance Imaging (fMRI), it is now known that the returning wave inevitably contains nonlocal quantum information about the object's internal organization and microscopic features, along with its external and macroscopic features (Schempp, 1992).

> . . . [Q]uantum information processing systems using quantum holography are . . . in worldwide medical diagnostic use in magnetic resonance imaging (MRI) systems (Schempp, 1998; Binz and Schempp, 2000; Binz and Schemp, 2000). In these systems, the diffraction (wave interference) patterns extracted by the magnetic resonant nuclear spin choreography to produce the desired medical images are easily shown to be holochoric in nature, ie [*sic*] to be quantum holograms as predicted by the theory of quantum holography, as identified by Schempp (1992), which is described in terms of the 3 dimensional nilpotent Heisenberg Lie Group. (Marcer, 2004)

Moreover, the complete event history of the object's movement in time through its 3-dimensional environment is carried by a quantum hologram: "It evolves over time to provide an encoded nonlocal record of the 'experience' of the object in the four-dimensional space/time as to its journey in space/time and the quantum states visited" (Mitchell, 2000, p. 299). Taken altogether, this produces a holographic process in which nonlocal quantum-level information about the object's organization and history is encoded and communicated back to the source of the initial wave.

Retrieval of this information by a human brain requires, first, that the individual calms his thoughts and emotions, and then directs his mind to a distant location (not visible to the eyes). The mental activity involved in "paying attention to" the location generates an outgoing wave directed externally towards the object. This establishes "phase-conjugate-adaptive-resonance" with the quantum-mechanical level of objects at the distant location whereby, insofar as vibratory resonance is maintained, the individual's neural system can apprehend quantum-holographically encoded information instantaneously available through quantum entanglement (Marcer and Schempp, 1997, 1998).

Mitchell (2000, p. 302) makes the important point that nonlocal quantum information can still be processed by the brain "even in the absence" of space-time (electromagnetic) signals to establish the phase-conjugate-adaptive-resonance condition. All that is required is an "icon," a symbol representing the object, which "seems sufficient" for the brain to pay attention to the object and to thus establish phase-conjugate-adaptive-resonance with the quantum level of the object. However, as noted earlier, in order to decode the spectrally encoded holographic phase-dependent information, a reference wave is required:

> Marcer (1998) has established, using Huygen's principle of waves and secondary waves, that *any* waves reverberating through the universe remain coherent with the waves at the source, and are thus sufficient to serve as the reference to decode the holographic information of *any* quantum hologram emanating from remote locations. (Mitchell, 2000, p. 302; my emphasis)

Once received, such quantum holographic information about distant objects is decoded and converted by the brain, through a Fourier transform process, into mental imagery, feelings, and other sensations as described by Pribram (1991).

Recapitulation

The brief overview of the theories of Tiller, and Mitchell, Marcer, and Schempp reveals a number of interesting commonalities and points of difference: both use a holographic approach that is based (implicitly, in Tiller's case) on the principles of quantum holography; both use quantum entanglement—the inherent interconnectedness and inseparability of everything at the quantum level—as the means to achieve nonlocal information communication; and both assign a key role to the body's mental and emotional state in establishing a bio-energetic means of connection to the energy fields of the external environment through which nonlocal information can be communicated.

However, although communication of intuitive information, in the theory of Mitchell, Marcer, and Schempp, can occur through *any* energy wave field (no matter whether it be quantum-mechanical, electromagnetic, acoustical, or another), which is comparable to Gabor's (1946) concept of the enfoldment of information in the oscillation of energy at "any frequency," Tiller endeavors to account for intuitive telepathic communication with energy waves of a *specific* frequency—that is, with superluminal magneto-electric wave propagation in his R-subspace of the zero-point energy field. Finally, Marcer's concept of phase-conjugate-adaptive-resonance—the mechanism for creating a reciprocal channel for nonlocal quantum holographic information communication between the percipient and the object—is a key idea. I expand on this concept, in what follows, to show how energetically encoded information can also be propagated, by harmonic resonance, through the wave fields of different energy frequencies and is communicated both within and across micro and macro scales of organization.

TOWARD A GENERAL THEORY OF INTUITION

Drawing on what is known about intuitive perception from the empirical research, and from the existing theories, each of which was developed to explain a specific mode of intuitive perception (telepathy, remote viewing, or intuitive foreknowledge), the outlines of a general theory of intuition can be constructed. In this effort I will be aided by Gabor's (1946) energy-based concept of information, as described above, because none of the other theories offers a rigorous definition of information, even though it is a fundamental term. But Gabor's notion is useful for another reason, in that his concept of information—the encoding of information in energy oscillations at *any* frequency—is a general concept that applies to energetic information communication at *both* the macro-scale of the 4-dimensional classical world and the micro-scale of quantum reality. Also, because their theory of the quantum hologram seems to fit best with the physics and psychophysiology of the information processing involved in intuitive perception, I will use the theory of the nonlocal quantum hologram from the work of Mitchell, Marcer, and Schempp as the foundation for what follows.

Outline of a Quantum-Holographic Theory

From the micro-scale of the quantum domain to the macro-scale of the 4-dimensional world, all objects and entities in the universe are energized in a constant state of oscillation at different energy frequencies. The energetic oscillations from all objects generate energy wave fields that radiate outward and interact. As a wave field of *any* kind interacts with a physical object, a part of the wave is reflected directly from the object's surface and part of the wave's energy is absorbed, causing the object to become energized and emit another wave outward back towards the source of the initial wave. The interaction among these wave fields generates an interference pattern that, at the moment of conjunction of the object and reference waves—the instant the interference pattern is created—both waves *are spatially and temporally coherent*. The interference pattern spectrally encodes information about the object's internal and external organization and also encodes its event history.

At the quantum level, the area of intersection in the interference pattern is a quantum hologram containing quantum level information reflecting this macro-scale process. Because the area of intersection involves an interaction between wave fronts, in which the radiation of energy in one wave front is modularized by the constraint of the wave front of radiating energy in the other, it is equivalent to Gabor's quantum or unit of energetic information, the logon ($\sim$½ cycle, see Figure 5).[19] This means that the quantum hologram is essentially a logon, or a Gaussian-constrained hologram, in Pribram's (1991) terms. And since each logon contains nonlocal information about the future, then each quantum hologram also contains quantum level information about the future organization of the macro-scale object with which it is associated. At the very least, this would provide an information processing mechanism by which moment-by-moment intuitive *anticipation* of future social order can occur, such as that involved in highly dynamic collectives like shoals of fish, flocks of birds, or herds of animals. It would also explain the intuitive anticipations of future action among the members of high performance human groups like music and dance ensembles, sports teams, special operations military units, and so forth (Bradley, 1996; Bradley and Pribram, 1998).

It can be shown (see Figure 7a), that when two interpenetrating wave fields are radiating synchronized oscillations at the same energy frequency, the conjunction of individual waves creates a spatially and temporally coherent channel of interaction connecting the object source points of the two wave fields (Bradley et al., 2004). This channel is essentially a logon pathway for optimal information communication, and it is also generated in systems involving multiple objects with synchronized oscillations at the same energy frequency (see Figure 7c). But this does not hold for interaction between wave fields radiating energy oscillations at varying frequencies (see Figure 7b); in such cases effective communication is impeded by spatial and/or temporal incoherence in the pattern of interpenetration between the wave fields.

However, when wave fields at different energy frequencies oscillate in *harmonic resonance*, as shown in Figure 8, a coherent channel of communication emerges

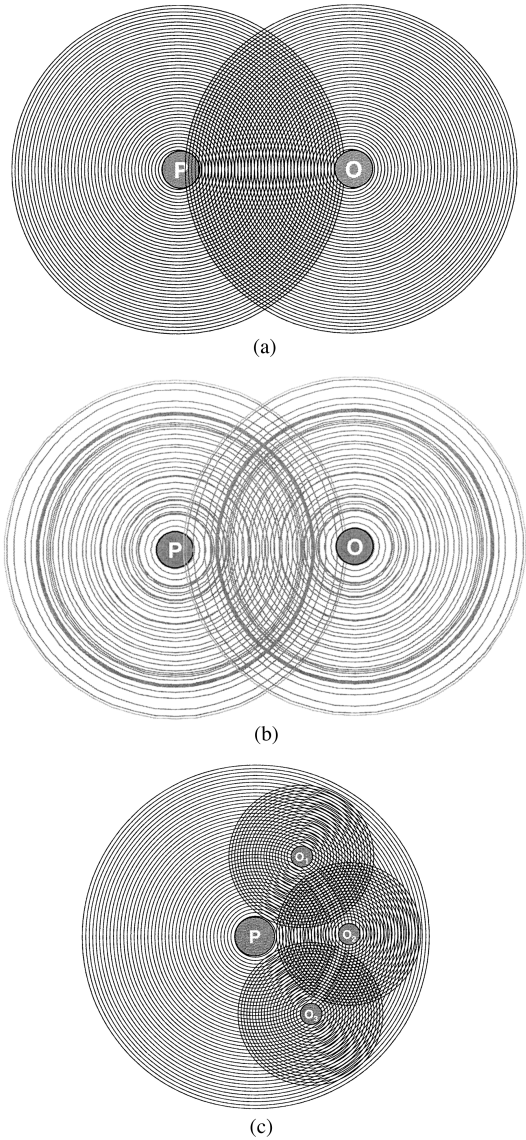

Figure 7. Figure 7a shows how a channel of coherent interaction is created between a percipient (P) and an object (O) when their two interpenetrating wave fields are radiating synchronized oscillations at the same energy frequency. This also holds for systems involving a percipient and multiple objects, as shown in Figure 7c; coherent channels of interaction are created both between the percipient and each object and also among the objects themselves. However, this does not hold for interaction between wave fields radiating energy oscillations at different frequencies, as shown in Figure 7b; effective communication is impeded by an incoherent pattern of interpenetration between the two wave fields (adapted from Bradley, McCraty, and Rees, 2004;).

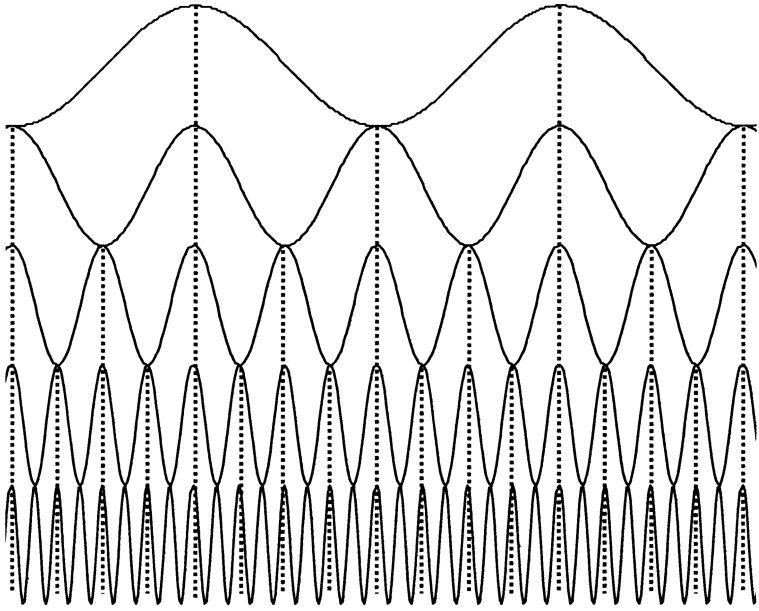

Figure 8. This figure depicts a set of wave fields at different energy frequencies in a harmonic series—two waves, four waves, eight waves, and so forth, per cycle, with synchronized wave peaks and troughs across the series. Note how a coherent channel of resonance emerges from synchronized oscillations across the wave fields, depicted with a dashed vertical line in the figure (©R.T. Bradley, 2006, all rights reserved).

from the radiation of synchronized oscillations across the wave fields. Thus when the set of wave fields constitute a harmonic series—two waves, four waves, eight waves, and so forth, per cycle, with synchronized wave peaks and troughs across the series, as shown—oscillatory resonance creates a coherent channel of communication across the different frequencies of individual wave fields (depicted with a dashed vertical line in the figure). This provides for a logon pathway of optimal nonlocal information communication across different scales of organization: from the quantum level micro-scale domain, to the 4-dimensional macro-scale world, and vice a versa. Because the overlap among logons means information about future order is spectrally enfolded, it is suggested that this creates an information processing mechanism by which foreknowledge of the future is contained in the logon or nonlocal quantum hologram at hand.

When the dynamics of these interactions are considered, information communication at hyper-speeds appears as an emergent property of the radiation of energy in the two wave fields. Using a simple dynamic model,[20] it can be shown that when two wave fields at the same energy frequency interact from opposing directions, a *third emergent wave field* is generated with wave fronts radiating at a *hyper-speed*, significantly faster than the rate of radiation of the original wave fronts. This third wave field radiates outward in all directions from the point source of the leading wave fronts in each wave field. It is suggested that this third wave field encodes

the quantum holograms created by the interaction of the two original wave fields, and, as such, is a likely mechanism for nonlocal information communication at hyper-speeds. It is further suggested that when wave fields from different scales of organization are in harmonic interaction, an emergent oscillatory resonance is generated for nonlocal information communication within and between macro and micro-scales of organization at hyper-speeds.

The act of conscious perception requires both an incoming wave field of sensory information about the object *and* an outgoing wave field of attentional energy. Based on recent research, it is clear that more than the brain is involved in the act of attention.[21] The body's psychophysiological systems generate numerous fields of energy, at various frequencies, that radiate outward from the body as wave fields in all directions. Of these, the heart generates the most powerful, rhythmic electromagnetic field. Not only does a massive deceleration in the heart's pattern of rhythmic activity occur at the moment of mental attention, which would generate a great change recorded in the outgoing wave field, but it is also clear from recent research that nonlocal perception is related to the percipient's degree of emotional arousal generated by an object of interest. It is the individual's *passion* or "rapt attention," as Radin (1997a) calls it—the biological energy activated in the individual's emotional connection to the object of his interest—that generates the outgoing attentional wave directed to the object. And because it is well established that the heart's energetic pattern of activity reflects feelings and emotional experience (Tiller et al., 1996; McCraty et al., 2006)[22]—which, even recorded, provides an *emotiograph* of different emotional states (see Figure 9)—it is likely that the heart is instrumental in generating the outgoing wave of attentional energy directed to the object.

The calming of extraneous thoughts and adoption of positive emotional interest involved in the act of "paying attention to" distant locales or nonlocal objects establishes a relationship of phase-conjugate-adaptive-resonance with the quantum level of an object at the distant location. Research at the Institute of HeartMath and elsewhere has found that attention is significantly enhanced when a focused, self-generated positive emotional state is sustained (McCraty, 2002; McCraty et al., 2006, pp. 32–37). Maintenance of a positive emotional state induces a shift to a coherent order in the heart's beat-to-beat pattern of rhythmic activity, marking the movement to a global state of increased synchronization and harmony in psychophysiological processes, referred to as *psychophysiological coherence* (McCraty et al., 2006). Compare, in Figure 9, the coherent order of smooth, sine-wave-like waveforms generated by the heart's beat-to-beat pattern of rhythmic activity during a sustained positive emotional state, such as appreciation or love, to the incoherent order of erratic, irregular waveforms produced in a negative emotional state like anger or frustration. Although the interpenetration between the outgoing coherent wave fields generated in the state of psychophysiological coherence and the incoming wave fields of quantum coherence from objects and events outside the body creates an oscillatory channel of energetic resonance for information communication, such communication is impeded when the body's psychophysiological systems are in a state of incoherence, as shown in Figures 7a and 7b.

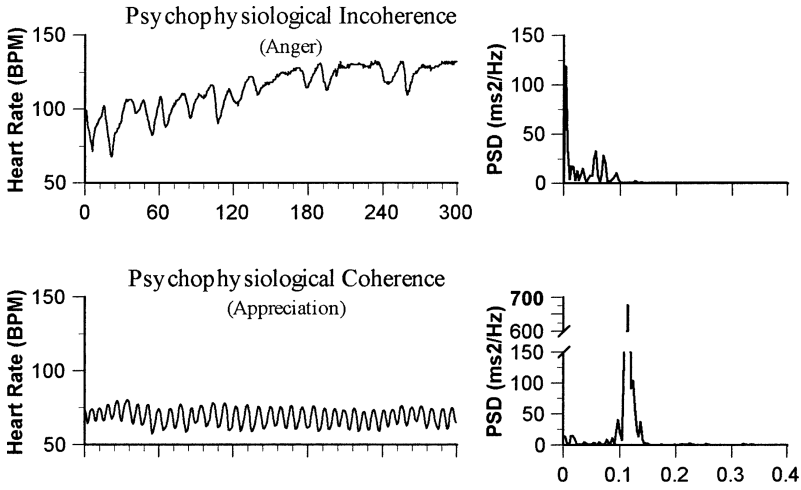

Figure 9. Emotiographs of heart rhythm patterns during two different psychophysiological modes. The left-hand graphs are heart rate tachograms, which show beat-to-beat changes in heart rate. To the right are the heart rate variability power spectral density (PSD) plots of the tachograms at left. Although there are individual variations in the HRV patterns associated with each mode, the examples depicted are typical of the characteristic aspects of the more general patterns observed for the two modes. Anger, an example of the *Psychophysiological Incoherence* mode, is characterized by a lower frequency, more erratic heart rhythm pattern and increasing mean heart rate. As can be seen in the corresponding power spectrum to the right, the rhythm during anger is primarily in the very low frequency region, which is associated with sympathetic nervous system activity. In this example, the anger was intense enough to drive the system into an extreme state, where the heart rhythm trace became flat (indicating very low HRV) around 200 seconds. *Psychophysiological Coherence*, which is associated with sustained positive emotions (in this example, appreciation), results in a highly ordered, sine wave–like heart rhythm pattern. As can be seen in the corresponding power spectrum, this psychophysiological mode is associated with a large, narrow peak in the low frequency region, centered around 0.1 Hz. Note the scale difference in the amplitude of the spectral peak during the coherence mode. This indicates system-wide resonance, increased synchronization between the sympathetic and parasympathetic branches of the nervous system, and entrainment between the heart rhythm pattern, respiration, and blood pressure rhythms. The coherence mode is also associated with increased parasympathetic activity, thus encompassing a key element of the relaxation response, yet it is physiologically distinct from relaxation because the system is oscillating at its resonant frequency and there is increased harmony and synchronization in nervous system and heart–brain dynamics (see McCraty et al., 2006, for further information. This figure was adapted from McCraty et al., 2006; ©Institute of HeartMath, reprinted with permission).

But there also is electrophysiological evidence of a "deeper" internal state in which the body's psychophysiological systems seem optimally organized for connection to and communication with the nonlocal quantum world. In the example from an Institute of HeartMath study (McCraty et al., 2006) shown in Figure 10,

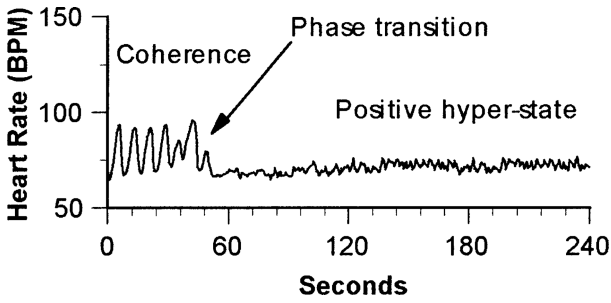

Figure 10. Phase-shift to a positive hyper-state. This figure shows a typical example of the phase transition observed in a subject moving from the Psychophysiological Coherence mode to a positive hyper-state referred to as Emotional Quiescence. Note the abrupt change from the larger-amplitude sine wave–like heart rhythm pattern distinguishing the Coherence mode to the much higher-frequency and lower-amplitude rhythm that marks the onset of the Emotional Quiescence positive hyper-state (adapted from McCraty et al., 2006; © Institute of HeartMath, reprinted with permission).

an individual undergoes a phase transition from the state of psychophysiological coherence to enter *emotional quiescence*—a qualitatively different "hyper-state" of emotional experience.[23] Notice how the slower-frequency, larger-amplitude, smooth, sine-wave-like pattern of heart rate variability for psychophysiological coherence rapidly transitions to the higher-frequency, lower-amplitude sine-wave-like pattern of emotional quiescence. Note also that when waterfall plots of consecutive amplitude spectra from ECG data are compared (see Figure 11),[24] the incoherent structure of the ECG spectra for a negative emotion like anger (Figure 11a) stands in strong contrast to the coherent structure of the ECG spectra for positive emotions in the state of psychophysiological coherence (Figure 11b) or in the state of emotional quiescence (see Figure 11c). Moreover, although the ECG spectra for emotional quiescence actually form a harmonic series, those for psychophysiological coherence do not. In the light of these data, it is postulated that while psychophysiological coherence provides a communication channel for intuitive perceptions that can inform day-to-day experience, the harmonic order of emotional quiescence is the channel, via *energetic resonance*, to a deeper connection to nonlocal quantum reality, whereby intuitive understanding—including spiritual insight—of oneself, others, and the underlying order of the universe is accessed.

To the degree that a coherent relationship of energetic resonance between the object and the percipient is maintained—that the object's quantum wave field and the attentional wave field of the percipient are locked in a resonant feedback loop—the individual's psychophysiological system (the brain, the heart, and the body as a whole) can receive and process nonlocal information as quantum holograms. In essence, it is the continuous resonant feedback loop between the outgoing coherent wave fields generated by the body's psychophysiological systems and the incoming wave fields from objects that is the basis of nonlocal perception,

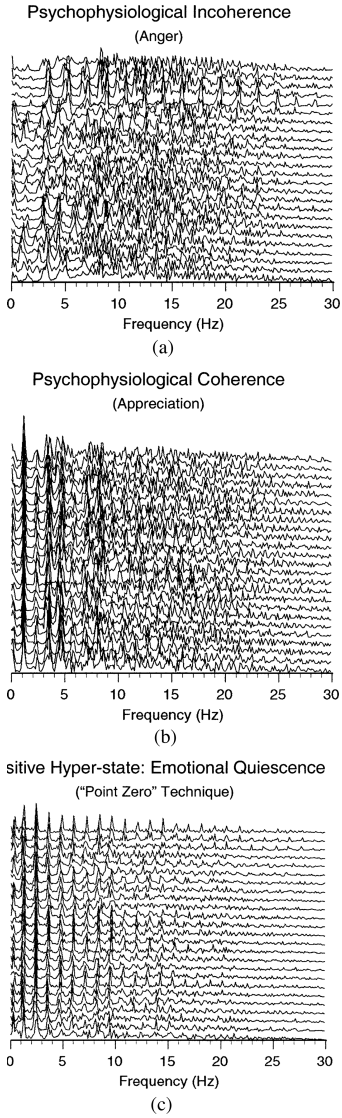

Figure 11. Waterfall plots of ECG spectra. Figure 11a shows a waterfall plot of ECG spectra for a negative emotion—anger—in the Psychophysiological Incoherence state. Note the lack of a coherent structure from spectrum to spectrum and the absence of harmonics in the spectra. Figure 11b shows a waterfall plot of ECG spectra for a sustained positive emotion—appreciation—in the state of Psychophysiological Coherence. These spectra display a rich complexity and high amplitude, yet retain a coherent structure from spectrum to spectrum. Figure 11c shows the waterfall plot of ECG spectra for the state of Emotional Quiescence. The coherent structure of standing waves, which form a harmonic series that is also constant from spectrum to spectrum, is due to the very low HRV in this mode (from McCraty et al., 2006; ©Institute of HeartMath, reprinted with permission).

in that the interaction between the two enables the body to receive and process quantum-holographic information about nonlocal objects and events spectrally encoded in the oscillatory radiation of energy.

One pathway of virtually instantaneous nonlocal information communication is at the quantum level through quantum coherence. Another pathway for information communication at hyper-speeds appears likely when a third emergent wave field is generated by the interaction between incoming and outgoing wave fields at the same frequency, or by harmonic resonance when wave fields of different frequencies interact, as described above. It is evident that the heart plays a significant role in the body's sensing and processing of the quantum holograms of nonlocal objects and events, in that our study of intuition, as noted earlier, found that the heart receives information about future events *before* the brain (McCraty et al., 2004b). It is even possible that the pre-stimulus heart-generated change in afferent neural signals observed in our study is actually a signal to the brain about the incoming quantum-holographically encoded information about the intuitive event. Once the pre-stimulus information is received by the brain, it is decoded and converted by the neural microstructure through a reverse Fourier transform process into mental imagery, feelings, and other sensations (Pribram, 1991).

Social Amplification of Intuition

Although the discussion to this point has focused on processes occurring within the individual, these processes of nonlocal communication are likely to be significantly amplified in certain kinds of social groups. Such conditions are that the group has a membership boundary, an engaging shared collective purpose or ideology, and, most importantly, that its members are bio-emotionally attuned to one another through a fully interconnected network of mutually reciprocated relations of positive affect modulated by relations of social control, as I have described elsewhere (Bradley, 1987; Bradley and Pribram, 1998). The harmonious group order that emerges from this bonding pattern generates a self-reinforcing collective field of coherent bio-emotional energy that operates as a powerful receptive field through which energetically encoded information about nonlocal objects and events is accessed at the quantum level.

This collective field amplifies the processing of intuitive information in several ways. First, it acts an attractor that, via the mechanism of frequency pulling, draws the energy frequency of the individual's bio-emotional wave field into harmony with the resonant frequency of the group as a whole. This makes it easier for each individual member of the group to generate and sustain a psychophysiologically coherent state, and therefore, to access nonlocal information. Second, through energetic resonance, the collective field is greatly amplified relative to its constituent components—the energy fields of the individuals. The result is that incoming information from nonlocal sources is amplified by the coherent collective order in much the same way that a signal of radio waves from distant stars and galaxies is amplified by an array of radio telescopes. For the individual group member, this provides stronger access to nonlocal information as compared to individuals who do not belong to such socially coherent groups. Finally, to the degree to which the group collectively focuses passionate attention

on a nonlocal object or event of common interest, the intuitive effect is further amplified.

Conversely, the processing of intuitive information is greatly impeded in socially incoherent groups—those in which connections among group members involve predominantly negative affect, as when social order is disrupted by emotional discord or by relations of disaffection, tension, and conflict. Under these conditions, the wave field of collective energy is too disorganized to access implicit information from nonlocal sources, and, therefore, impedes the individual's access to intuition.

Some support for these expectations comes from a remote viewing study conducted in a three-day conference workshop in Northern Italy (Targ and Katra, 2000). The researchers gave great attention to "creating a feeling of community and coherence of intention within the group" of 24 participants who were previously unacquainted, and report successful matches with the remote targets with an effect size of 0.64 (Targ and Katra, 2000: 107). This is markedly higher than the effect size of 0.20 or less typically found in ESP experiments in group and classroom settings where "lack of attention, coherence of feelings, seriousness of purpose, and motivation" and poor training of research subjects are thought to account for the difference (Targ and Katra, 2000: 108). Targ and Katra's research suggest a significantly enhanced amplification of the nonlocal communication effect in socially coherent groups.[25]

Hypothesis of Passionate-Attentional Resonance

By way of a summary of the theory, I want to show how this account of the psychophysiological and quantum-holographic processes by which intuitive perception occurs in the individual leads to a plausible hypothesis amenable to empirical verification.

The individual's passionate attention—that is, the biological energy activated in his/her emotional connection to the object of interest (e.g., the love between two geographically separated family members, or the passionate quest for future opportunities in a certain field of business)—attunes the individual to the object's unfolding pattern of activity and to the implicit order of its future potential. Both the pattern of activity and the potential future order are spectrally encoded as a quantum hologram in a field of potential energy as implicit information in a domain apart from space and time. At a biological level, the body's psychophysiological systems generate numerous fields of radiating energy, at various frequencies, that interpenetrate the field of potential energy. Of these, the heart generates the most powerful rhythmic electromagnetic field, which radiates outward from the body in all directions.

When the individual quiets the mind, calms any feelings of unease, and directs passionate attention to the object, a global shift to psychophysiological coherence is induced. This shift establishes a state of attentional resonance with the incoming quantum-level information from the object of interest. Such attunement brings the outgoing wave field of attentional energy from the individual's psychophysiological systems into oscillatory resonance with the incoming quantum wave field of coherent energy from the object. The energetic resonance

between the two wave fields creates a channel for communication of nonlocal information, which is optimized when the wave fields of energy generated by the body's psychophysiological systems are organized as a harmonic series. This occurs when the individual shifts into the deeper internal state of emotional quiescence.[26]

These considerations lead to the following hypothesis: *the more the individual can maintain coherent passionate-attentional interest directed to the object of interest, the more the body's psychophysiological systems will have access (via harmonic resonance) to this implicit field of quantum-holographic nonlocal information, and, hence, the greater the likelihood of intuitive foreknowledge about the object of interest*.[27]

It is further postulated that access to this implicit field of nonlocal information is significantly amplified when the individual is the member of a coherent social group. By attuning all members to the same resonant socio-emotional frequency, the group generates a powerful collective receptive field of coherent bio-emotional energy through which implicit nonlocal information is accessed and amplified due to a stronger resonant feedback loop, both to the field of the group and to that of the individual member. This eases the individual's shift to a state of psychophysiological coherence and facilitates access to implicit information from nonlocal sources, thereby providing stronger access to intuition. Moreover, when the group collectively focuses passionate attention on a nonlocal object or event of common interest, the stronger energetic resonance between the outgoing collective field of attentional bio-emotional energy and the incoming wave field of energetically encoded information from the object further amplifies the intuitive signal. This leads to a second hypothesis: *the more socio-emotionally coherent the group, the greater the access to and amplification of nonlocal information, and the greater the likelihood of intuitive foreknowledge about nonlocal objects and events*.

CONCLUSION

Intuition belongs to a class of nonlocal consciousness phenomena that has eluded the light of scientific understanding and has long remained an enigma. Included in this class are intriguing yet perplexing phenomena such as ESP, clairvoyance, remote viewing, and other forms of nonlocal communication often collectively referred to as *psi*. Although there can be no scientific doubt about the existence of these phenomena, as the large volume of rigorous experimental evidence briefly reviewed here shows, explaining *how*—the mechanisms and processes by which—such space/time-defying communication occurs has not been possible until relatively recently.

Three scientific developments have opened the door to rational explanation. The first is the discovery of the hologram—specifically, the principle of distributed organization by which information about an object is spectrally encoded throughout a field of potential energy by the radiating oscillations of energy waveforms. The second is the discovery of quantum entanglement or nonlocality—that everything in the universe at the subatomic level is interconnected and nonseparable. The third is the discovery of quantum coherence—that subatomic emissions from macro-scale

objects are not random but exhibit coherence at the quantum level, reflective of an object's material organization and event history.

Coupling these developments in physics with recent psychophysiological evidence, on the involvement of positive emotions in nonlocal communication, provides the key to the door of scientific understanding. This has made possible an account of intuition that is rational—one that does not rest on unverifiable metaphysical processes or invoke divine or supernatural intervention; an account that is grounded in known sensory systems in the body and psychophysiological processes of information communication—one that does not require postulation of a yet-to-be-discovered sixth sense; and an account that is scientifically verifiable. In short, as Mitchell points out:

> It is likely that most, if not all, subtle, ephemeral and unexplained phenomena associated with subjective experience are connected, directly or indirectly, with the phenomenon of nonlocality. . . . Nonlocality and the nonlocal quantum hologram provide the only testable mechanism discovered to date which offers a possible solution to the host of enigmatic observations and data associated with consciousness and such consciousness phenomena. (Mitchell, 2000, p. 299)

We stand at the threshold of a new era in scientific understanding of one of humankind's oldest and greatest enigmas: the perception of information about things far away in space or yet to happen in time. The theory outlined in this work aims to provide a rational and empirically verifiable explanation of this phenomenon of intuition and, more broadly, an understanding of nonlocal communication. As developed in a forthcoming work (Bradley, 2006b), the fundamental principles upon which this theory is based have more general utility in that they also offer a scientific account for the even more perplexing phenomenon of nonlocal agency—the intentional focus of bio-emotional energy to produce subtle but significant (scientifically measurable) effects on objects and events distant in space/time. A scientific explanation of these interrelated phenomena of nonlocal interaction promises not only to profoundly change our understanding of the universe and our connection to it in the deepest possible way, but it will also affect how we view ourselves and our constructive influence on things distant or in the future.

NOTES

1. I am grateful to Peter Reynolds for this gem.
2. See Radin (1997a) for the most comprehensive contemporary review of this research. Also see Bernstein (2005) and Walach and Schmidt (2005) for recent reviews.
3. For example, precognition, involving intuitive thoughts, is defined in the *McGraw-Hill Dictionary of Scientific and Technical Terms* (1994, p. 1565) as "a form of extrasensory perception involving foreknowledge of a future event."
4. See Radin (1997a, Chap. 13) for a discussion of the major criticisms of *psi* research; see Alcock (1981), Blakemore (1996), Hyman (1996), and Marks (1986) for the skeptic's view.
5. Event-related potentials are voltage fluctuations that are associated in time with some physical, mental, or emotional occurrence. These potentials can be recorded from the scalp and extracted from the ongoing electroencephalogram (EEG) by means of filtering and signal averaging.
6. These researchers had previously found that increased psychophysiological coherence correlates with significant improvements in performance on tasks requiring attentional focus and subtle

discrimination (McCraty, 2002; McCraty et al., 2006), and thought, therefore, that the psychophysiological state could also enhance the processing of intuitive information.

7. The RNGs are hardware circuits that use inherent electronic noise to generate truly random bits. Each RNG is attached to a personal computer that collects 200 random bits per second and transmits packets of data over the Internet to a central server in Princeton, New Jersey, USA, for data archiving. By May 2002, the GCP network comprised approximately 50 RNGs located throughout North and South America, Europe, Asia, Africa, and Australia (Radin, 2002). See Nelson (2002) and Radin (2002) for further information about the GCP and more details about the devices, data processing, and statistical analysis procedures employed.
8. The plots are the cumulative sum of normalized autocorrelation coefficients for the second-by-second inter-RNG variance measure, calculated for all lags up to 4 hours over the 24-hour period of universal coordinated time (UTC).
9. The "pseudo data" are a control calculation from a pseudo-random clone data set generated for the day of 11 September 2001.
10. Scargle (2002) and May and Spootiswoode (2002) offer a different interpretation of the 11 September 2001 data.
11. To construct these four new space-time dimensions, they multiply the original 4 dimensions of space-time by the square root of $-\mathbf{1}$ (conventionally symbolized as the coefficient $\boldsymbol{i}$), which creates an 8-dimensional space-time universe in which any two points are always adjacent. Rauscher and Targ note that eight dimensions are the minimum number of dimensions required, if quantum nonlocality, as empirically demonstrated by the Aspect and Gisin experiments (Aspect et al., 1982; Tittel et al., 1998), is to remain consistent with the Poincare and Lorentz invariances.
12. There is also empirical evidence that communication of information in social systems appears to be organized according to holographic principles (see Bradley, 1987, 2003; Bradley and Pribram, 1998).
13. There is compelling evidence that holographs are created by many living organisms in nature to process sensory information (Farhat, 1980; Schueler, Lee, and Wade, 1984) which accords the organism an evolutionary advantage for survival (Marcer, 2004). Studies have found that flies, fish, birds, and mammals—including humans—all process sensory information about objects in their external environments holographically. Following Karl Pribram's (1971, 1991) pioneering work in developing a quantum-holographic theory to explain perception and memory in the brain, studies in humans have shown that chemical oscillations and cellular oscillations, and also macro-scale oscillations of heart activity all strongly suggest that holographic-like processing not only exists at the neural level, but also at the cellular, molecular, and global levels of physiological function (see McCraty et al., 2006).
14. It should be noted that because photographs record the intensity changes and not the phase-shifts of the light waves bouncing off the object, only a 2-dimensional image of the object can be recorded.
15. This is radically different from, although related to, the more commonly used concept of information, *reduction of uncertainty*, developed by Claude Shannon (1949), in which information is digitally encoded into a sequence of BITs (the **BI**nary digi**T**—the smallest unit of information) to form a signal. Used in logical and computational systems, the uncertainty of the meaning of a signal is incrementally reduced by the successive addition of units of information, in much the same way that the resolution of the meaning of this sentence is increased with the addition of each word.
16. However, it should be noted, as Pribram (1991, chap. 2) points out, that a Gaussian or a rectangular function will also serve as the constraint to modularize the signal's encoding in energy.
17. This is my term and characterization, not Tiller's. Although he does not label it as such, Tiller is actually describing a quantum-holographic process (see later): a distributed order of energy frequency—a field of magneto-electric waves—coupled to a space-time constraint—modulation of the magnetic waves by informational content of a human mind at a given point in time and at a given location in space.
18. "Marcer (1997) has proposed that . . . resonance requires a virtual path mathematically equal but opposite to the incoming sensory information about the object. Further, that it is the incoming space/time information (visual, acoustic, etc.), which decodes the information of the quantum hologram and establishes the condition of pcar [phase-conjugate-adaptive-resonance] so that accurate three dimensional perception is possible" (Mitchell, 2000, p. 297).

19. Recall that his concept of information—*minimum of uncertainty*—involves the minimum area of interaction between a harmonic oscillation of energy at any frequency and an energetic signal impulse, which can be a Gaussian (wave-shaped) constraint, in which the signal's information can be spectrally encoded with fidelity.
20. Two overhead transparencies, each depicting a series of arcs drawn at the same frequency to represent wave fronts in a wave field, are moved across each other in opposing directions.
21. See the review of research in McCraty et al. (2006).
22. The research shows that information about a person's emotional state is communicated both throughout the body *and* into the external environment via the heart's pattern of activity. The rhythmic patterns of beat-to-beat heart activity change significantly as we experience different emotions, which can be recorded with electrophysiology instrumentation to provide a visual—an *emotiograph*—of the pattern of beat-to-beat activity associated with a given emotion, as shown in Figure 9 (also see Figures 4 and 7, McCraty et al., 2006). In turn, these changes in the heart's beating patterns create corresponding changes in the structure spectra of the electromagnetic field radiated by the heart, as discussed in a moment (see McCraty et al., 2006).
23. The subjective experience of emotional quiescence is a state in which the intrusion of normal mental and emotional "chatter" is reduced to a point of internal quietness, to be replaced by a profound feeling of peace and serenity and a deep sense of being centered in the heart. First-person descriptions include a heightened awareness of the movement of energy both within one's body and between oneself and other people; the feeling of being "totally alive" and "fully present" in the moment; the experience of an all-embracing, nonjudgmental love (in the largest sense); and a sense of increased connectedness with one's higher self or spirit, and with "the whole" (McCraty et al., 2006, pp. 33–34, 37–43).
24. Each trace in the waterfall plots shown in Figure 11 is the electromagnetic spectrum of the actual electrocardiogram recording of an individual over a 6-second period. Together, the set of traces cover a continuous time period (approximately 2 ½ minutes) and show the degree of stability in the structure of the waves of electrical activity generated by the heart during this time. These electromagnetic traces were derived from the same recordings of ECG signals that were used to measure the heart rhythms and the HRV spectra of those heart rhythms shown in Figure 9, and they should not be confused with the power spectra of the HRV waveforms, shown in Figure 9. There is a direct relationship between the heart rhythm patterns (HRV) and the spectral information encoded in these radiating electromagnetic fields. This is due to the fact that the distribution of the harmonic relationships and magnitudes of the various peaks in the ECG spectrum are dependent on the length of the interbeat intervals (the temporal space between consecutive heartbeat spikes) and the distribution pattern of the interbeat intervals within the heart rate series (heart rhythm patterns) (from McCraty et al., 2006, pp. 53–54).
25. This is consistent with the conclusion of Nelson et al. (1998) who list group resonance in emotionally meaningful contexts, subjective and emotional contents, profound personal involvement, deeply engrossing communication, spiritual engaging situations as situations in which nonlocal information communication effects are most likely.
26. Based on the finding that intentional activation of a global shift to psychophysiological coherence is associated with intuitive foreknowledge (McCraty, Atkinson, and Bradley, 2004b), there is a good likelihood that such intuitive ability is a perceptual skill that can be enhanced using the positive emotion-focused techniques that Childre has developed (see Childre and Martin, 2000; Tomasino, in press).
27. A study to test this hypothesis is currently underway in an experiment, using electrophysiological measures of heart and ANS activity, to measure the intuitive ability of a sample of successful entrepreneurs from the Cambridge Technopol in England. A just completed pilot test of the experimental protocol found clear evidence that the entrepreneurs' ANS systems received decision outcome information some 6–7 seconds before the outcome was known (Gillin et al., 2007).

REFERENCES

Agor, W. 1984. *Intuitive management: Integrating left and right brain skills*. New Jersey: Prentice Hall.

Alcock, J. E. 1981. *Parapsychology: Science or magic? A psychological perspective*. Elmsford, NY: Pergamon Press.

Aspect, A., P. Grangier, and G. Roger. 1982. Experimental realization of Einstein-Podolsky-Rosen-Bohm Gedanken experiment: A new violation of Bell's inequalities. *Physical Review of Letters* 49: 91–94.

Aspect, A. 1999. Bell's inequality test: More ideal than ever. *Nature* 398 (18 March): 189–190.

Bekenstein, J. D. 2003. Information in the holographic universe. *Scientific American* 289(2): 58–65.

Bem, D. J. 2003. *Precognitive habituation: Replicable evidence for a process of anomalous cognition*. Unpublished manuscript.

Bernstein, P. 2005. Intuition: What science says (so far) about how and why intuition works,. In *Endophysics, Time, Quantum and the Subjective*, Eds. Buccheri, R., Elitzur, A. C., and Saniga, M. Singapore: World Scientific, pp. 251–269.

Bierman, D. J. 2000. Anomalous baseline effects in mainstream emotion research using psychophysiological variables. *Proceedings of Presented Papers*, The 43rd Annual Convention of the Parapsychological Association. Freiburg Breslau, Germany, August 17–20.

Bierman, D. J. and Radin, D. I. 1997. Anomalous anticipatory response on randomized future conditions. *Perceptual and Motor Skills* 84: 689 –690.

Bierman, D. J. and Scholte, H. S. 2002. Anomalous anticipatory brain activation preceding exposure of emotional and neutral pictures. Paper presented, *Toward a Science of Consciousness IV*, Tuscon, AZ.

Blakemore, S. J. 1996. Reply to "Do you believe in psychic phenomena?" *The Times Higher Education Supplement* (April 5) v.

Bohm, D. 1980. *Wholeness and the implicate order.* London: Routledge.

Bohm, D., and Hiley, B. J. 1993. *The undivided universe.* London: Routledge.

Bradley, R. T. 1987. *Charisma and social structure: A study of love and power, wholeness and transformation*. New York: Paragon Press.

Bradley, R. T. 1996. The anticipation of order in biosocial collectives. *World Futures* 49: 93–116.

Bradley, R. T. 1998. Values, agency, and the theory of quantum vacuum interaction. In *Brain and values: Is a biological science of values possible*, chap. 18, Ed. Pribram, K. H. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 471–504.

Bradley, R. T. 2002. Dialogue, information, and psychosocial organization. In *Transformative power of dialogue,* chap. 10. Ed. Roberts, N. C. London: Elsevier Publications, pp. 243–288.

Bradley, R .T. 2003. Love, power, mind, brain, and agency. In *The great adventure: Toward a fully human theory of evolution,* chap. 4. Ed. Love, D. New York: SUNY Press, pp. 99–150.

Bradley, R. T. 2006a. The psychophysiology of entrepreneurial intuition: A quantum-holographic theory. Paper presented to the 3rd International Entrepreneurship Research Exchange conference held at UNITEC, Auckland, New Zealand (7–10 February 2006).

Bradley, R. T. (2006b—forthcoming). A quantum-holographic theory of the psychophysiology of nonlocal interaction.

Bradley, R. T., McCraty, R., and Rees, R. 2004. *Proposal concept for a study of highly effective and transformational teaching*. Unpublished manuscript. Boulder Creek, CA: The Institute of HeartMath.

Bradley, R. T., and Pribram, K. H. 1998. Communication and stability in social collectives. *Journal of Social and Evolutionary Systems* 21(1): 29–81.

Childre, D. L., and Martin, H. 2000. *The HeartMath solution*. San Francisco: HarperCollins.
Don, N. S., McDonough, B. E., and Warren, C. A. 1998. Event-related brain potential (ERP) indicators of unconscious psi: A replication using subjects unselected for psi. *Journal of Parapsychology* 62: 127–145.
Eisenhardt, K., and Zbaracki, M. 1992. Strategic decision making. *Strategic Management Journal* 13: 17–37.
Farhat, N. H. 1980. Holography and inverse scattering. Special Issue on Dennis Gabor Memorial Symposium on Holography, *Israel Journal of Technology* 18(5): 218–223.
Gabor, D. 1946. Theory of communication. *Journal of the Institute of Electrical Engineers* 93: 439–457.
Gabor, D. 1948. A new microscopic principle. *Nature* 161: 777–778.
Gillin, M., LaPira, F., McCraty, R., Bradley, R. T., Atkinson, M., Simpson, D., and Scicluna, P. 2007. Before cognition: The active contribution of the heart/ANS to intuitive decision making as measured in repeat entrepreneurs in the Cambridge Technopol. Paper accepted for presentation to the Fourth AGSE International Entrepreneurship Research Exchange, Brisbane, Australia, 6–9 February 2007.
Hogarth, R. M. 2001. *Educating intuition*. Chicago, IL: The University of Chicago Press.
Honorton, C., and D. Ferrari. 1989. Future-telling: A meta-analysis of forced-choice precognition experiements, 1935–1987. *Journal of Parapsychology* 53: 281–308.
Hyman, R. 1996. Evaluation of a program on anomalous mental phenomena. *Journal of Scientific Exploration* 10: 31–58.
Jahn, R. G. 2001. The challenge of consciousness. *Journal of Scientific Exploration* 15(4): 443–457.
Jahn, R. G., and B. J. Dunne. 2001. A modular model of mind/matter manifestations $(M)^5$. *Journal of Scientific Exploration* 16(3): 299–329.
Laughlin, C. 1997. The nature of intuition: A neuropsychological approach. In *Intuition: The inside story*, Eds. Davis-Floyd, R., Arvidson, P.S. London: Routledge, pp. 19–37,
Laszlo, E. 1995. *The interconnected universe: Conceptual foundations of transdisciplinary unified theory*. Singapore: World Scientific.
Laszlo, E. 2003. *The connectivity hypothesis: Foundations of an integral science of quantum, cosmos, life, and consciousness*. New York: SUNY Press.
Lieberman, M. D. 2000. Intuition: A social and cognitive neuroscience approach. *Psychological Bulletin* 126(1): 109–137.
Marcer, P. 2004. Status of the mission, *Cybernetic Machine Specialist Group*, British Computer Society, Available at www.bcs.org.uk/sggroup/cyber/status.htm (accessed October 16, 2005).
Marcer, P., and Mitchell, E. 2001. *What is consciousness? The physical nature of consciousness*, Amsterdam—Philadephia: John Benjamins, pp. 145–174.
Marcer, P., and Schempp, W. 1997. Model of the neuron working by quantum holography. *Informatica* 21: 519–534.
Marcer, P., and Schempp, W. 1998. The brain as a conscious system. *International Journal of General Systems* 27: 231–248.
Marks, D. F. 1986. Investigating the paranormal. *Nature* 320: 119–124.
May, E., and Spootiswoode, J. 2001. Memorandum for the record, re: analysis of Global Consciousnesses Project's data near the 11 September 2001 events. Available at http://noosphere.princeton.edu/papers/Sep1101.pdf (accessed September 20, 2006).
May, E. C., Utts, J. M., Trask, V. V., Luke, W. W., Frivold, T. J., and Humphrey, B. S. 1988. Review of the psychoenergetic research conducted at SRI International (1973–1988), *SRI International Technical Report (March)*.

McCraty, R. 2002. Influence of cardiac afferent input on heart-brain synchronization and cognitive performance. *International Journal of Psychophysiology* 45(1–2): 72–73.

McCraty, R., Atkinson, M., and 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., and 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., Tomasino, D., and Bradley, R. T. 2006. *The coherent heart: Heart–brain interactions, psychophysiological coherence, and the emergence of system-wide order*. (publication # 06-022.) Boulder Creek, CA: HeartMath Research Center, Institute of HeartMath.

McCraty, R., Bradley, R. T., and D. Tomasino. 2004–2005. The resonant heart. *Shift* special issue—"The Science of Fields," No. 5, Dec. 2004–Feb.2005:15–19.

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

McDonough, B. E., Don, N. S., and Warren, C. A. 2002. Differential event-related potentials to targets and decoys in a guessing task. *Journal of Scientific Exploration* 16(2): 187–206.

Mitchell, E. 2000. Nature's mind: The quantum hologram. *International Journal of Computing Anticipatory Systems* 7: 295–312.

Mitchell, E. 2004. Quantum holography: A basis for the interface between mind and matter. In *Bioelectromagnetic Medicine*, chap. 10, Eds. Rosch, P. G. , Markov, M. S. New York: Dekker, pp. 153–158.

Myers, D. G. 2002. *Intuition: Its powers and perils*. New Haven, CT: Yale University Press.

Nadeau, R., and Kafatos, M. 1999. *The nonlocal universe: The new physics and matters of the mind*. New York: Oxford University Press.

Nelson, R. D. 2001. The correlation of global events with REG data: An internet-based, nonlocal anomalies experiment. *Journal of Parapsychology* 65: 247–271.

Nelson, R. D. 2002. Coherent consciousness and reduced randomness: Correlations on September 11, 2001. *Journal of Scientific Exploration* 16(4): 549–570.

Nelson, R. D., Jahn, R. G., Dunne, B. J., Dobyns, Y. H., and G. J. Bradish. 1998. FieldREG II: Consciousness and field effect: Replications and explorations. *Journal of Scientific Exploration* 12(3): 425–454.

Penrose, R. 1989. *The emperor's new mind: Concerning computers, minds, and the laws of physics,* Oxford, UK: Oxford University Press.

Pribram, K. H. 1971. *Languages of the brain: Experimental paradoxes and principles in neuropsyhology*. New York: Brandon House.

Pribram, K. H. 1991. *Brain and perception: Holonomy and structure in figural processing*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Puthoff, H. E. 1996. CIA-initiated remote viewing program at Stanford Research Institute. *Journal of Scientific Exploration* 10: 63–76.

Puthoff, H. E., and Targ, R. 1976. A perceptual channel for information transfer over kilometer distances: Historical perspective and recent research. *Proceedings of the Institute of Electrical and Electronic Engineers* 64: 329–254.

Radin, D. I. 1997a. *The conscious universe: The scientific truth of psychic phenomena*. San Francisco: HarperEdge.

Radin, D. I. 1997b. Unconscious perception of future emotions: An experiment in presentiment. *Journal of Scientific Exploration* 11: 163–180.

Radin, D. I. 2002. Exploring the relationship between random physical events and mass human attention: asking for whom the bell tolls. *Journal of Scientific Exploration* 16(4): 533–547.

Radin, D. I. 2004. Electrodermal presentiments of future emotions. *Journal of Scientific Exploration* 18: 253–273.

Rauscher, E., and Targ, R. 2001. The speed of thought: Investigation of a complex space-time metric to describe psychic phenomenon. *Journal of Scientific Exploration* 15: 331–354.

Rhine, J. B. 1964. *Extra-sensory perception*, Boston, MA: Bruce Humphries.

Rhine, J. B. 1981. *The invisible picture: A study of psychic experiences*, Jefferson, NC: McFarland.

Rolland, R. 1956. *Mémoires et fragments du Journal*, Paris: Albin Michel.

Scargle, J. D. 2002. Was there evidence of global consciousness on September 11, 2001? *Journal of Scientific Exploration* 16(4): 571–577.

Schlitz, M. J., and Braude, W. 1997. Distant intentionality and healing: Assessing the evidence. *Alterative Therapies* 3: 87–88.

Schempp, W. 1992. Quantum holography and neurocomputer architectures. *Journal of Mathematical Imaging and Vision* 2: 109–164.

Schueler, C. F., Lee, H., and Wade, G. 1984. Fundamentals of digital ultrasonic processing. *IEEE Transactions on Sonics and Ultrasonics* 31(4): 195–217.

Shannon, C. E. 1949. The mathematical theory of communication. In *The Mathematical Theory of Communication*, Eds. Shannon, C. E., Weaver, W. Urbana, IL: The University of Illinois Press, pp. 3–91,

Targ, R. 1994. Remote viewing replication evaluated by concept analysis. *Journal of Parapsychology* 58: 271–284.

Targ, R., and Katra, J. E. 2000. Remote viewing in a group setting. *Journal of Scientific Exploration* 14: 107–114.

Tart, C. 1963. Physiological correlates of psi cognition. *International Journal of Parapsychology* 5: 375–386.

Tiller, W. 1999. Towards a predictive model of subtle domain connections to the physical domain of reality: Origins of wave-particle duality, electric-magnetic monopoles and the mirror principle. *Journal of Scientific Exploration* 13(1): 41–67.

Tiller, W. 2004. Subtle energies and their roles in bioelectromagnetic phenomena. In *Bioelectromagnetic Medicine*, chap 11, Eds. Rosch, P. G., Markov, M. S. New York, Dekker, pp. 159-192.

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

Tittel, W., Brendel, J. , Zbinden, H., and Gisin, N. 1998. Violation of Bell inequalities by photons more than 10 km apart. *Physical Review of Letters* 81: 3563–3566.

Tomasino, D. E. 2007; in press. The psychophysiological basis of creativity and intuition: accessing "the zone" of entrepreneurship. *International Journal of Entrepreneurship and Small Business*.

Turnbill, H. W. 1961. *The correspondence of Isaac Newton, Vol. 3*. Cambridge: Cambridge University Press.

Walach, H., and Schmidt, S. 2005. Repairing Plato's life boat with Ockham's razor: The important function of research in anomalies for consciousness studies. *Journal of Consciousness Studies* 12(2): 52–70.

Warren, C. A., McDonough, B. E., and Don, N. S. 1992a. Event-related brain potential changes in a psi task. *Journal of Parapsychology* 56: 1–30.

Warren, C. A., McDonough, B. E., and Don, N. S. 1992b. Partial replication of single event-related potential effects in a psi task. *Journal of Parapsychology* 56: 1–30.