Nonlocal Intuition in Entrepreneurs and Non-entrepreneurs: Results of Two Experiments Using Electrophysiological Measures

Int. J. of Entrepreneurship and Small Business » 2011 Vol.12, No.3 pp *343-372*

Raymond Trevor Bradley
Institute for Whole Social Science, Capitola, California, USA
Institute of HeartMath, Boulder Creek, California, USA
e-Motion Institute, Auckland, New Zealand

Murray Gillin
Australian Graduate School of Entrepreneurship, Swinburne University of Technology, Melbourne, Australia

Rollin McCraty
Institute of HeartMath, Boulder Creek, California, USA

Mike Atkinson
Institute of HeartMath, Boulder Creek, California, USA

Please address all correspondence to:
Dr. Raymond Bradley
Institute for Whole Social Science
1118 Sutherland Lane, #4
Capitola, CA 95010, USA
Tel.: (831) 331-5882
Email: wholesocialscience@sbcglobal.net

Nonlocal Intuition in Entrepreneurs and Non-entrepreneurs: Results of Two Experiments Using Electrophysiological Measures

ABSTRACT

What explains the success of repeat entrepreneurs? A team of researchers from the Australian Graduate School of Entrepreneurship (AGSE) and the Institute of HeartMath (IHM) have been investigating the proposition that nonlocal intuition accounts for the repeat entrepreneur's extraordinary ability to locate future business opportunities. *Nonlocal intuition* is the perception of energetically encoded information about a future event by the body's psychophysiological systems, which informs entrepreneurial decision and action; this information is *not* based on reason or memories of prior experience. This work reports the results of two experiments testing the measurement efficacy of two computer administered experimental protocols—a Business Case protocol and a Roulette protocol—for studying nonlocal intuition in entrepreneurs and non-entrepreneurs. Conducted on a small sample of repeat entrepreneurs from the Cambridge Technopol, U.K., and a somewhat larger U.S. sample of non-entrepreneurs, both experiments employed electrophysiological measures (skin conductance response and heart rhythm patterns) to detect nonlocal intuition. The results are promising, as the evidence shows that the electrophysiological measures appear able to detect nonlocal intuition in both entrepreneurs and non-entrepreneurs. As far we know the results from this study constitute the first evidence that physiological measures of entrepreneurs' intuitive response are predictive of future outcomes. While based on relatively small samples, these results are consistent with the findings of previous studies.

Keywords

Entrepreneurship, Emotional Energy, Intuition, Nonlocal Communication, Passionate Attention, Psychophysiology, Quantum-Holographic Theory, Small Business

INTRODUCTION

As a key element in a healthy, thriving economy, successful entrepreneurs are innovators and risk-assessors who often have extraordinarily accurate hunches about the locus of future opportunities (Mitchell et al., 2005; Shane & Venkataraman, 2000). Yet after more than a half-century of research (Barron, 2004), the explanation for entrepreneurial success still remains perplexingly elusive.

Early research to identify the personality traits and other individual characteristics that distinguish the entrepreneur yielded little success (Brockhaus & Horwitz, 1985; Gartner, 1986). Nowadays most scholars agree that what differentiates entrepreneurs from other actors in the economy is their behavior. But not only have definitive results from research on this question yet to be realized (Keh et al., 2002; Mitchell et al., 2002), but significant aspects of entrepreneurial behavior—such as creativity, intuition, and divergent thinking—have largely been studied from a cognitive perspective (Mitchell et al., 2005; Shane, 2003).

Cognitive approaches to understanding entrepreneurial behavior have emphasized the key question of opportunity recognition: that it is the *way* successful entrepreneurs process information to locate potential future business opportunities that distinguishes them from other business actors (Larsen & Bundsen, 1996; Hahn & Chater, 1997; Shane & Venkataraman, 2000). This has led to an effort to link various pattern recognition models with entrepreneurial decision-making behavior (Keh et al., 2002; Mitchell et al., 2002). And while there has been a growing recognition that entrepreneurs tend to be more intuitive and less logical/analytic in how they make decisions when responding to the temporal demands of competitive markets (Allison & Hayes, 1966; La Pira & Gillin, 2006), typically such "intuition" is thought to arise from unconscious, cognitive extrapolations of prior experience (Mitchell et al., 2005; Myers, 2002; Simon, 1987).

Certainly there is little doubt that prior experience—both conscious and unconscious knowledge—plays an important role in informing entrepreneurial decision and action. However, we propose that there is another source of intuitive information that enables the entrepreneur to access information regarding future opportunities—namely, information about future events that is received and processed by the brain, heart, and autonomic nervous system (ANS) (McCraty et al., 2004a, 2004b; Radin, 1997a) . We call this *nonlocal intuition* to emphasize that such intuitive perception is ***not*** based on memory of prior experience. Moreover, this tacit information is not accessed by the dispassionate cognitive processing that underlies reason and logic. Rather, it is the entrepreneur's *passionate focus* on his mission in economic life that attunes his body's psychophysiological systems, by a process of energetic resonance, to intuitive information from nonlocal sources.

In this work we report the results of two experiments investigating nonlocal intuition in entrepreneurs and non-entrepreneurs. The experiments were conducted as part of a series of pilot investigations testing the development of two new computer administered experiment protocols for use in conjunction with electrophysiological measures of nonlocal intuitive perception. In addition to evidence on the efficacy of the two protocols, we also present the results of the experiments which show clear evidence of nonlocal intuition in both our samples of entrepreneurs and non-entrepreneurs.

INTUITION

The Concise Oxford Dictionary (1964: 639) defines *intuition* as "immediate apprehension by the mind without reasoning, immediate apprehension by a sense, and immediate insight." Roberto Assagioli (1971: 27) observes that intuition is "a synthetic function in the sense that it apprehends the totality of a given situation or psychological reality. It does not work from the part to the whole but apprehends a totality directly in its living existence." Such intuitive experience is quite unlike that of normal cognitive awareness, in which the mind's contents are updated incrementally, as the sequences of sensory experience unfold (McCraty et al., 2004a).

Cognitive Perspective

The ability to quickly see both the whole and the key details of a situation is an important element of successful entrepreneurial behavior. It is by seeing the "bigger picture" that entrepreneurs are able to integrate disparate information—about the environment, people, events, and technology—into a holistic framework of meaning that provides the basis for decisive, and often effective,

action (Mitton, 1989). It is, therefore, entirely appropriate to consider intuition, as just defined, as integral to entrepreneurial decision and action (La Pira & Gillin, 2006).

The dominant view among those who study intuition is that intuitive perception is largely the result of past experience—a function of the unconscious mind accessing existing information within the brain from prior experience (e.g., Agor, 1984; Laughlin, 1997; Lieberman, 2000; Myers, 2002; Mitchell et al., 2005; 2007). For example, Simon's (1983, 1987) notion of intuition is the application of one's professional judgment to the situation; it is based on the accumulated knowledge and decision-making skill acquired by long experience of successes and failures in practice. This viewpoint stems from the common assumption in neuroscience that the mind is emergent from the brain, and therefore subject to the same physical constraints as all biological systems, in which time flows from the past to the future. Thus, awareness is thought to be restricted to perceptions of the present intermingled with memories of the past (McCraty et al., 2004a).

Drawing on the neuroscience conception of the human brain as a highly efficient and effective pattern-matching device (Pribram, 1971), a number of so-called "pattern-recognition" models have been developed to show how fast, "intuitive" decision and action by the entrepreneur can be understood purely in terms of cognitive processes in which the brain matches the patterns of existing opportunities facing the entrepreneur with stored templates in memory based on prior experience (Larsen & Budsen 1996; Hahn & Chater, 1997; Craig & Lindsay, 2001).

Nonlocal Perspective

While there is little doubt that prior experience—both conscious and unconscious knowledge—plays an important role in informing entrepreneurial decision and action, there are also instances when accurate "gut feelings" or "intuitive insights" about distant or future—*nonlocal*—events are found to be scientifically valid and occur under controlled conditions that preclude information from past experience (see Radin, 1997a). Not only is there clear experimental evidence that the body's psychophysiological systems can receive and process information about a future event *before* the event happens (e.g., Bierman & Scholte, 2002; McCraty, Atkinson, & Bradley, 2004a; 2004b; Radin, 1997 & 2004), but there is now also a theory describing how such nonlocal communication may occur (Bradley, 2006, 2007, & 2009; Bradley & Tomasino, 2009). The theory explains how the entrepreneur's passionately focused attention directed to an object of interest—such as a future business opportunity—attunes the bio-emotional energy generated by the body's psychophysiological systems to a domain of quantum-holographical information, which contains implicit, energetically encoded information about the object.

Taking an information processing perspective, *nonlocal intuition* is viewed as a process by which implicit information normally outside the range of cognitive processes is sensed and perceived by the body's psychophysiological systems as certainty of knowledge or feeling (positive or negative) about the totality of a some thing distant or yet to happen (McCraty, Atkinson, & Bradley, 2004a; 2004b). The physical and psychophysiological processes involved, raise the physiological signal levels to possible measurement levels (Tiller 2001). 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 absolute—the intuition is experienced as beyond question or doubt—and the feeling can encompass positive emotions, such as love, appreciation, and optimism, or negative emotions like dread or fear. Also, the experience of nonlocal 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 in studies using electrophysiological instrumentation, as described next (McCraty, Atkinson, & Bradley, 2004a; 2004b).

PREVIOUS RESEARCH

In earlier empirical research on repeat entrepreneurs in the Cambridge Technopole (UK) to asses the propensity of non-local intuition in decision making characteristics, the concept of "triangulation" was used to seek insights into non-local intuition. The two assessments previously evaluated were Cognitive Style Index and in-depth interviews (LaPira and Gillin 2006). The third leg of the triangle—namely, experimental evidence from electrophysiological measures of intuition (McCraty, Atkinson, & Bradley, 2004a & 2004b)—is the subject of this work.

Electrophysiological Measures of Intuition

Although there is now a large body of rigorous experimental research dating back more than seventy years documenting the phenomenon of nonlocal intuitive perception,[1] mainstream science still regards the findings of these studies as anomalous (Walach & Schmidt, 2005). This is despite the fact that such accurate foreknowledge of the future is a phenomenon that has been studied and consistently documented in rigorous scientific experiments for many decades, and is something that *cannot* be explained by flaws in experimental design or research methods, statistical techniques, chance, or selective reporting of results (Radin, 1997a). 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 prior experience (Agor, 1984; Eisenhardt & Zbaracki, 1992; Hogarth, 2001; Laughlin, 1997; Lieberman, 2000; Mitchell et al., 2005; Mitchell et al., 2007; Myers, 2002). In presenting a very brief review of the evidence from studies that challenge this view, we draw heavily on McCraty, Atkinson, & Bradley (2004a) and Bradley (2007).

The notion that intuitive perception is purely a function of the unconscious mind accessing forgotten prior experience has been challenged by several recent studies. Using rigorous experimental protocols and electrophysiological instrumentation, these studies have shown that the body often responds to a future emotionally arousing stimulus four to seven seconds *prior* to experiencing the stimulus (Radin, 1997b; Bierman, 2000; Radin, 2003; Spottiswoode & May, 2003; McCraty, Atkinson, & Bradley, 2004a & 2004b).

The first studies we are aware of to examine changes in brain activity that preceded an unknown stimulus were conducted by Levin and Kennedy (1975). They observed a significantly larger contingent negative variation (CNV) which is a slow brain wave potential associated with anticipation, expectancy, or cortical priming just before subjects were presented a target stimulus. Warren et al. later found significant differences in event-related potentials (ERP) between target and non-target stimuli presented during forced-choice precognition tasks (Warren et al., 1992). 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

[1] See Radin's comprehensive review (1997a), or Bradley's (2007) summary.

the ERP effect was an indicator of "unconscious precognition," since the study participants' overt guessing accuracy did not differ from chance expectations.

More recently, a number of researchers have explored physiological predictors of future events by investigating whether the human autonomic nervous system could unconsciously respond to randomly selected future emotional stimuli (e.g., Spottiswoode & May, 2003; May Paulinyi, & Vassy, 2005). 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 & Radin, 1997; Bierman & 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 & Scholte, 2002). Moreover, a recent study, conducted by McCraty, Atkinson, and Bradley (2004a & 2004b), augmented Radin's protocol by adding measures of brain response (EEG) and heart rhythm activity (ECG) and found that not only did both the brain and heart receive the pre-stimulus information some 4-5seconds before a future emotional picture was randomly selected by the computer, but that the heart received this information by about 1.5 seconds *before* the brain (see Figure 1). Finally, a just published study (Tressoldi et al. 2009), using random presentation of "pleasant" and "unpleasant" acoustical stimuli, found corroborating evidence of the heart's involvement in predicting future events.

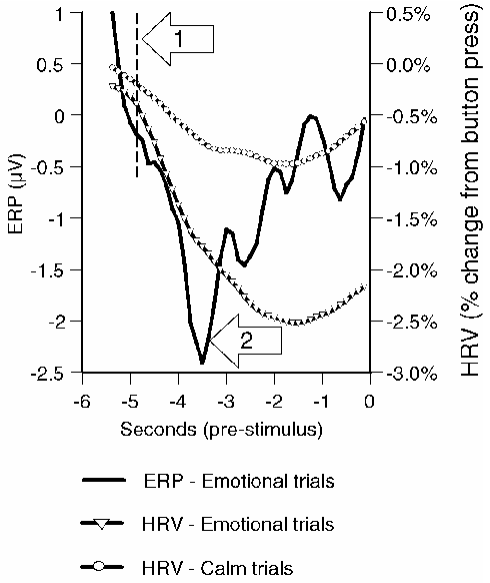


Figure 1. Temporal Dynamics of Heart and Brain Pre-stimulus Responses
This overlay plot shows the mean event-related potential (ERP) at FP2 and heart rate deceleration curves for the female subgroup (n = 15) in condition 1 during the pre-stimulus period. (The "0" time point denotes stimulus onset.) The 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), while 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).

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*. In short, the important conclusion from these studies is that intuitive perception of a future event is related to the degree of emotional significance of that event. Moreover, that the response to and processing of pre-stimulus information about a future event is not confined to the brain. Instead, the evidence suggests that the heart responds first and then the brain and possibly other organs in the body are all involved together in responding to nonlocal intuitive information.

HYPOTHESIS OF NONLOCAL INTUITION

As part of IHM's research effort on intuition, Bradley has developed a quantum-holographic theory of intuition which offers an understanding of the physical and psychophysiological processes by which entrepreneurial intuition occurs (Bradley, 2006, 2007, 2009; Bradley & Tomasino, 2009). Drawing on the principles of quantum holography (Bradley & Pribram, 1998; Gabor, 1946; Pribram, 1991; Marcer & Schempp, 1998), the theory 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, energetically encoded information about the object. The body's perception of such implicit information about things distant in space/time is experienced as an intuition:

> The entrepreneur's passionate attention—that is, the biological energy activated in his emotional connection to the object of interest (e.g., the quest for future opportunities in a certain field of business)—attunes him 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 energy, at various frequencies, that interpenetrate the field of potential energy. Of these, the heart generates the most powerful rhythmic electromagnetic field, which radiates out from the body in all directions.
>
> When the entrepreneur calms his mind and feelings, and adopts a heart-focused state of positive emotion directed to the object, a global shift to psychophysiological coherence is induced which optimizes 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 entrepreneur'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 (Bradley, 2006: 179).

The theory leads to the following hypotheses:

1. The more the entrepreneur maintains passionate attentional interest directed to the object of interest, the greater the psychophysiological systems' access to an implicit field of quantum-holographic information and the greater the intuitive foreknowledge about the object of interest (Bradley, 2006: 179).

Also, drawing on research[2] documenting a physiological mode frequently associated with sustained positive emotions—described as *psychophysiological coherence*[3]—which conforms to the state of energetic resonance described in the theory, it can be postulated, following McCraty, Atkinson, and Bradley (2004a, 2004b) and Tomasino (2007), that:

2. Being in a state of psychophysiological coherence is expected to enhance intuitive ability.

RESEARCH DESIGN AND METHOD

To explore the efficacy of this approach to measuring intuition in entrepreneurs, a team of researchers from the AGSE and the IHM have been conducting a series of investigations using both cognitive (La Pira & Gillin, 2006; Gillin et al., 2006) and electrophysiological measures of intuitive perception (Gillin et al., 2007; Bradley et al., 2008). This work reports the results of two pilot study experiments: the first on a small sample of repeat entrepreneurs; the second on a slightly larger sample of non-entrepreneurs who had been practicing emotion self-regulation techniques.

The pilot experiments were conducted to test the measurement efficacy of a new experimental protocol (described below) for measuring nonlocal intuition in both entrepreneurs and non-entrepreneurs in preparation for a large-scale study, which is now being conducted comparing nonlocal intuition in entrepreneurs in Australia, the UK, and USA. One key aspect of the protocol is a computer-administered gambling experiment with and a Roulette Wheel stimulus designed and pre-tested by McCraty and Atkinson (2003). To more directly target the entrepreneurial domain, we also added a Business Case stimulus developed by La Pira and Gillin (2006). In what follows, we present the procedures and results of each pilot study separately—starting with that for repeat entrepreneurs, and bring their results together for a comparative analysis. The hardware used to record the electrophysiological measurements in each of the pilot studies is described in Appendix 1.

---

[2] See, McCraty et al. (1995); McCraty et al. (2006); Tiller, McCraty, and Atkinson (1996).

[3] IHM's research has shown that psychophysiological coherence mode encompasses distinct but related physiological phenomena including entrainment, resonance, and synchronization, which reflect more efficient and harmonious interactions among the body's subsystems (McCraty & Childre, 2002, 2004; Tiller et al., 1996). Correlates of psychophysiological coherence include: increased synchronization between the two branches of the autonomic nervous system, a shift in autonomic balance toward increased parasympathetic activity, increased heart-brain synchronization, increased vascular resonance, and entrainment between diverse physiologic oscillatory systems. The coherent mode is reflected by a smooth, sine wave-like pattern in the heart rhythms and a narrow-band, high-amplitude peak in the low frequency range of the heart rate variability power spectrum, at a frequency of about 0.1 Hz (Tiller et al., 1996). McCraty, (2002) and McCraty and Atkinson, (2003) have previously found that increased heart rhythm coherence correlates with significant improvements in performance on tasks requiring attentional focus and subtle discrimination which may be important elements of the intuitive effect studied here (see McCraty et al., 2006, for a review).

REPEAT ENTREPRENEUR EXPERIMENT

In the last 20 years the Cambridge (UK) Technopole has become a beacon for regional development incorporating a strong University presence, high technology repeat entrepreneurs, cluster developments and associated access to capital (Segal et al., 1985; Herriot, 2003; Myint et al., 2004; Library House, 2004). As Myint et al. note, "The majority of high technology companies that have shaped the success of the Cambridge cluster are connected to a handful of repeat entrepreneurs, business angels and venture capitalists as their involvement in developing new ventures have been repeatedly evidenced on the charts" (Myint et al., 2004). It was these considerations that led to the selection of the Cambridge Technopole as the research site for the study.

Repeat entrepreneurs were chosen for this research because they are most likely to have demonstrated that their success is more than luck alone: that they have beaten the odds against success (Fiet, Van et al. 2004). Operationally, repeat entrepreneurs were defined as those entrepreneurs who have had two or more successful ventures. Using the Myint et al. (2004) data, seventeen successful repeat entrepreneurs in the Cambridge Technopole (UK) were asked to participate in the study. Each participant had demonstrated a capacity for intuition with the self generation of a genuine response to opportunity recognition, per La Pira and Gillin's (2006) study, and was an owner of a firm with less than 199 employees. [4] However, due to unanticipated technical difficulties with the hardware for recording electrophysiological measures under field conditions, usable data were available for ten participants.

Testing Procedure

In the experimental sessions for the pilot study, each participant was seated in a comfortable chair. A video monitor was located approximately one meter in front of the participant at eye level, and a computer mouse was attached for the participant to click when ready to initiate each trial. Participants were told that they were participating in a trial to test their capacity for making reliable investment decisions with minimal data and analysis. The protocol involves a two step process; a roulette protocol—the Roulette experiment—followed by an investment decision in a potential growth company—the Business Case experiment. The operational logic of each experiment is shown in Figure 2, below. Both experiments were administered back to back, after a short break, in a controlled setting in the presence of the experimenter.

The Roulette Experiment

Using the principle of a roulette wheel, this test is based on choosing an investment amount (bet) and then making a choice of red or black and comparing the result with that generated in the future by a random generated choice. The participants have the option of choosing from four investment amounts, ranging from 25 cents to $2.00. Once they select the button of their choice the test begins. The sound of a roulette wheel is triggered after six seconds. The result of each run is tallied on the bottom left-hand side of the screen so that the participant knows whether he/she is winning or losing and by how much. After a cool down period a message appears to repress the button. This experiment was replayed 25 times before the participant moves to the next stage, the company investment experiment.

[4] We used the criteria set down by the Australian Bureau of Statistic's (A.B.S., 1998) definition of a Small to Medium Enterprise, (SME).

The Business Case Experiment

The second half of the protocol involves the participants making a choice on an investment decision in a potential growth company. Sixty actual firms were chosen for the stimulus in this experiment and entered and saved on the computer as a database. Twenty-six of the firms had failed and thirty-four of the firms were successful at the time of selecting the cases. Firms were chosen from a range of industries, countries and levels of failures and successes. Where at all possible mixtures of both successful and failed firms for the same industry were included so that the participant could not presume that a firm in a particular industry is more likely than not to fail or succeed (Gillin, Lapira, & Scicluna, 2006).

The participant is presented with a company profile of very limited information—enough to interest an entrepreneur but not enough information to identify the company cognitively. Under conditions of uncertainty, such as limited information, Allison et al., (2000) found intuitive decisions were more likely to occur. The limited information presented was:

Type of industry
Private or public ownership
Management team (professional management team or entrepreneur)
Current Funding

The participant has an investment bank of $100,000, they may choose either to invest or not-invest a proportion of the total bank. After the participant has made his/her choice according to the investment options available, the randomly selected company appears after a 6 second delay whereby the computer confirms the company as a success or failure and tallies the results of the investment. The protocol seeks an investment decision from the entrepreneur following the presentation of a randomly generated stimulus—the profile of a potential high growth company. The subject presses the "Start" to begin the experiment (Figure 2), after which there is a delay period of five seconds before the randomly selected "Investment Choice" screen is presented. A delay period of six seconds follows the subject's investment choice, after which the result is displayed. Another delay period of five seconds follows, and then the "Next" button appears to begin the next trial. The experiment is repeated over 25 trials.

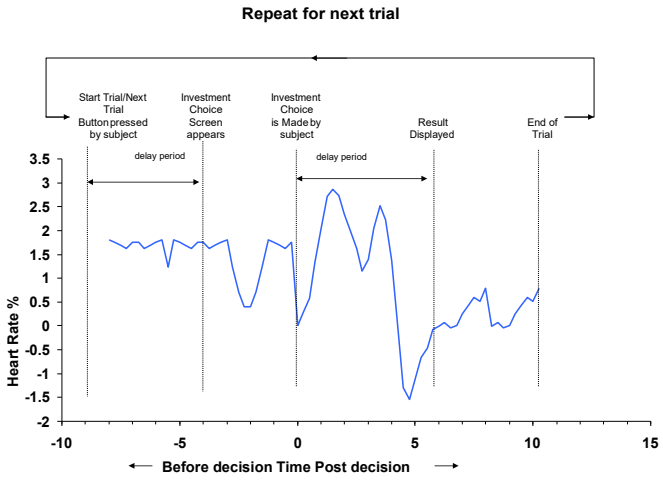


Figure 2. Test Protocol for the Experiment

Data and Statistical Analysis

Skin Conductance Measures

Because measurement focused on how the physiology changed from the moment a given trial was initiated, each sample in each trial was transformed into a percentage difference score relative to the *baseline* SCL value at the moment the participant pressed the button to initiate the given trial ("button press"). To compute the percentage difference score (D), the first data point in each trial was subtracted from each of the 152 points (19 seconds X 8 samples per seconds) in the series. Then each point in the series was divided by the original value of the first data point of the series to yield the percentage difference series, in which the first point is always zero.

Heart Rate Variability

ECG data used for heart rate variability (HRV) analysis were all normal sinus intervals. All aberrant beats and artifacts were removed from the records: a computer algorithm eliminated intervals that varied by more than 30% of the mean of the previous four intervals, and any remaining artifacts were removed during second-stage editing by an experienced technician who visually inspected the records. A regularly spaced time series was derived from the succession of normal RR intervals by linear interpolation of the irregularly spaced series and then resampled at 8 samples per second.

Statistics for SCL and HRV

To reduce the possibility of false-positive findings, a deliberate decision was made to use statistically conservative procedures for data analysis, following McCraty et al. (2004a & 2004b). Therefore, because it controls for autocorrelations inherent to physiological signals and their underlying non-normal distributions (Blair and Karniski, 1993), randomized permutation analysis (RPA) was used to determine statistical significance of the differences between win and loss curves during the prestimulus period. Applied separately to each individual's SCL and HRV data, RPA generates one standard deviate, or *z* score, per person, which is the post-choice pre-result the differential value—i.e., the win/loss difference (Good, 1994; Hjorth, 1994; Radin, 1997b). For the RPA, we calculated a random distribution that was constructed over 2,000 permutations.

Results

Figure 3 presents the grand average of the physiological recordings for all participants during the post-investment period. The two graphs in the top half of the figure show the mean pattern of the recordings for beat-to-beat heart rate for the Roulette Experiment and the Business Case Experiment. There is evidence of separation between wins and losses in the mean heart rate pattern for the Roulette Experiment that begins at about *6 seconds prior* to the occurrence outcome result being displayed. However, the mean heart rate curves for wins and losses in the Business Case Experiment show little evidence of separation and are virtually the same.

The two graphs in the bottom half of Figure 3 show the mean pattern of skin conductance recordings for each experiment. Across all subjects the mean skin conductance pattern in the Roulette Experiment is quite erratic—especially for the loss curve—which suggests an invalid

and thus inconclusive result. For the Business Case Experiment, a small separation between wins and losses begins about five seconds before the result is displayed and increases slightly during the post-investment pre-display period.

Figure 3. Grand Average (All Subjects) of Physiological Recordings During the Post-Intervention Choice Period

Random Permutation Analysis

The results of a random permutation analysis (RPA) across all 8 subjects (not shown) produced no significant findings for this sample of entrepreneurs as a group. This is not surprising given the high degree of individual variation in the physiological measures and the small sample size (N = 8).

More promising, are the results of the RPA by individual (Table 1). The electrophysiological instrumentation has identified five instances involving four entrepreneurs (Subjects 17, 18, 19 and 20) in which the individual had significant or marginally significant predictive power in discriminating future outcomes. For example, the results for Subject 17 (Figure 4) indicate that the HRV waveforms significantly predicted the future win/loss outcome during the Roulette Experiment ($z = 2.06$, $p = 0.02$, signif.), while the skin conductance measure did not ($z = 1.08$, $p = 0.141$, n.s.). Interestingly, the results for the Business Case Experiment were reversed: this entrepreneur's skin conductance measure significantly predicted the future outcome ($z = -2.08$, $p = 0.019$), while the HRV did not ($z = -0.34$, $p = 0.367$). For Subject 18 (Figure 5), although there was evidence of clear separation of the win/loss curves for the skin conductance measures in both the Roulette experiment ($z = -2.50$, $p = 0.400$, n.s.) and the Business Case

experiment (z = -1.46, p = 0.073, m.s.), the HRV results show little evidence of discriminatory ability to predict future win/loss outcomes.

Table 1. Random Permutation Analysis Results by Individual

Roulette experiment

	Beat-to-Beat Heart Rate				Skin Conductance			
	Observed	z	p =		Observed	z	$p \sim^{\alpha}$	
S3	-30.49	-0.68	0.247		-5.56	-0.14	0.446	
S5	16.75	0.96	0.170		NA	NA	NA	
S16	0.38	-0.09	0.466		5.73	0.40	0.346	
S17	73.35	2.06	0.020	*	15.59	1.08	0.141	
S18	8.30	0.30	0.381		-9.81	-0.25	0.400	
S19	8.41	0.35	0.362		-71.52	-1.39	0.082	†
S20	NA	NA	NA		16.17	0.66	0.256	
S21	19.73	1.08	0.141		NA	NA	NA	

α Based on 2000 random permutations.

Business case experiment

	Beat-to-Beat Heart Rate			Skin Conductance		
	Observed	z	p =	Observed	z	$p \sim^{\alpha}$
S3	-16.84	-1.15	0.125	-2.42	-0.40	0.345
S5	NA	NA	NA	NA	NA	NA
S16	16.19	0.96	0.169	0.33	0.14	0.445
S17	-1.77	-0.34	0.367	-12.69	-2.08	0.019 *
S18	-4.85	-0.27	0.395	-13.53	-1.46	0.073 †
S19	-6.22	-0.52	0.302	17.48	0.77	0.221
S20	NA	NA	NA	-17.51	-2.06	0.020 *
S21	7.56	1.16	0.123	NA	NA	NA

α Based on 2000 random permutations.

* $p < 0.05$

† $p < 0.1$

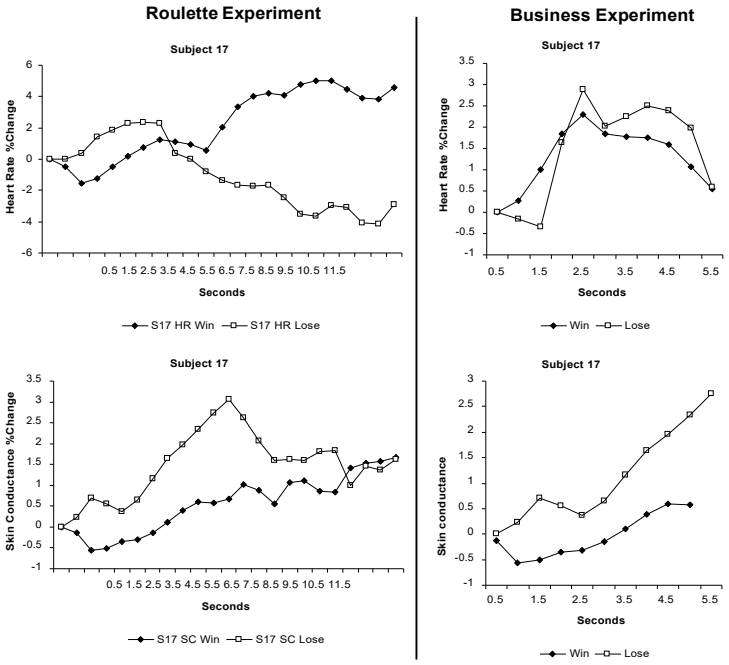


Figure 4. Mean Results (over 25 trials) of Electrophysiological Measures for Subject 17

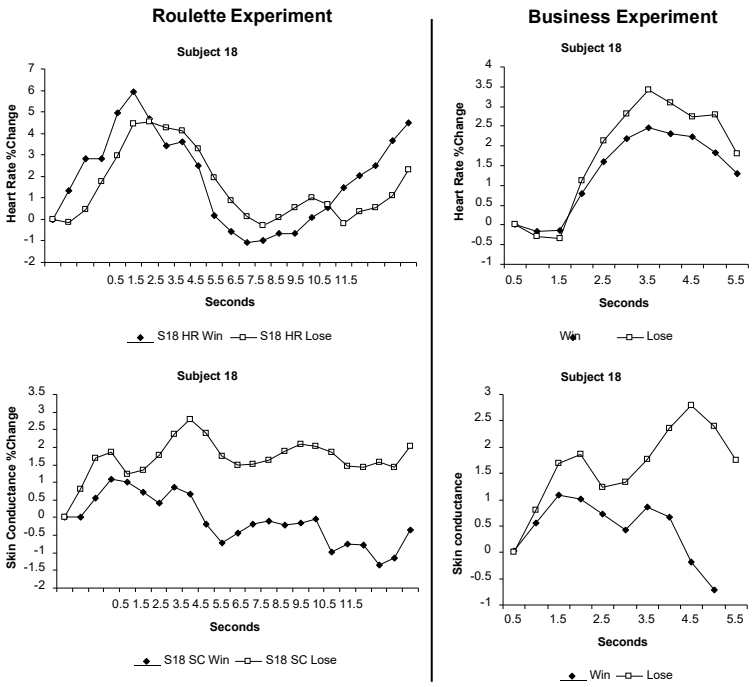


Figure 5. Mean Results (over 25 trials) of Electrophysiological Measures for Subject 18

While somewhat mixed results, they are promising, given the extremely rigorous statistical requirements of the RPA method. Overall, there is compelling evidence that the electrophysiological measures were able to detect intuitive perception of a future outcome in four of the eight entrepreneurs.

We hold our discussion of these results until after we have presented the study on non-entrepreneurs.

NON-ENTREPRENEUR EXPERIMENT

For this study, we obtained a sample of non-entrepreneurs from the U.S. who had been practicing specific emotion self-regulation techniques designed to enhance intuitive ability. The participants were administered the Roulette experiment protocol in an eight-session repeated measures study. As described above, the Roulette protocol was designed to obtain generic baseline electrophysiological measures—skin conductance level (SCL) and the electrocardiogram (ECG) for HRV—of intuitive ability in any population. We were interested in investigating two questions:

1. The degree to which a nonlocal intuitive effect, as detected by electrophysiological measures, remains stable over time. This is an important issue, since there is some evidence that repeated administration of an experiment involving nonlocal information/interaction leads to a decline in the experimental nonlocal effect observed (Jahn et al., 2003).

2. The degree to which there is a difference between the inherent intuitive ability of repeat entrepreneurs and a group of non-entrepreneurs who have been practicing emotional management techniques designed to enhance intuitive ability. This could provide some initial evidence on the all-important applied question of whether intuitive ability can be intentionally developed and enhanced (Tomasino, 2007).

Testing Procedure

Following a review of its performance in the repeat entrepreneur experiment, we made two changes to the format of the Roulette protocol designed to enhance measurement of a nonlocal intuitive effect: we extended the length of the pre-stimulus post-decision period by an additional 5 seconds and partitioned the physiological data recording into distinct pre-bet, post-bet, and post-result periods; and to improve the participant's motivation, we increased the betting incentive as described next.

Using a repeated-measures design, the protocol for the Roulette experiment was administered eight times over a two month time frame: 2 sessions, back-to-back ± 3 days with a two week interval between the back-to-back sessions; each session involved 26 trials.[5] Thirteen non-entrepreneur participants took part in this experiment under controlled laboratory conditions, from whom usable data were obtained from 12 participants. Participants were told that they were participating in a gambling experiment and to win as much as possible over the course of 26 bets. As an incentive, the participants began with a $20.00 credit and were told that they would be paid in cash any amount that they won beyond the $20.00. At the start of each session there was a four-minute period for recording baseline physiological data. Once the instructions were read, the participant completed the experiment alone—without the presence of the experimenter.

Data Analysis and Results

The data were processed and analyzed using the same procedures as described above, in the entrepreneur intuition experiment. One noteworthy difference was that for the RPA, the random distribution was constructed over 1,000,000 permutations, instead of 2,000 permutations.

Within each session, each of the 26 trials was divided into three segments: the pre-bet period (4 seconds), the post-bet period (12 seconds), and the post-result period (6 seconds). The post-result period is important because it is a validation of the expected emotional response of the participant to finding out whether they won or lost their bet. The change in the investment incentive (starting with a $20.00 credit and a cash payment of any positive balance when concluded) to boost the participant's emotional engagement, appears to have been successful. The pattern of the win/loss curves (Figure 6) are consistent with expected physiological responses indicative of a participant's pre-stimulus emotional engagement and also his/her post-result emotional reaction to the betting outcome.

We follow next with the results on the stability of electrophysiological measures of a nonlocal effect. However, because the results for repeat entrepreneurs and non-entrepreneurs are being presented separately with their respective experiments, we will hold the comparison of the two groups until the discussion of the results of both experiments below.

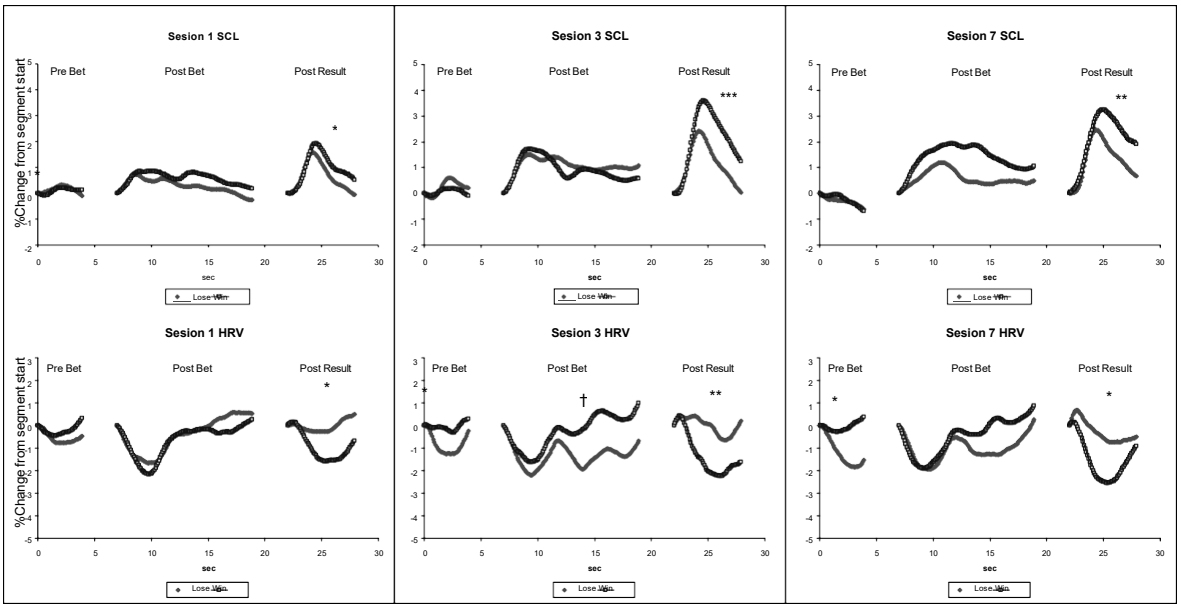
[5] The hardware set up is described in the Appendix.

Stability of the Intuitive Effect

With respect to the question of the over-time stability of physiological measures of nonlocal intuition, we present results from the first, third, and seventh experimental sessions to give the reader a sense of the patterns in the physiological data in relation to win/loss outcomes at the beginning, middle, and end of the eight experimental sessions. Figure 6 presents the grand average for the physiological recordings by win/loss outcome for these three sessions for all 12 participants with usable data for the three segments of the experiment: the pre-bet period, the post-bet period (these two segments are the pre-stimulus periods—the time *prior* to the randomly chosen bet red/black outcome), and the post-result period.

The graphs in the top half of the figure show the mean pattern of the skin conductance recordings for each experiment session. While there is limited separation between the win/loss curves in the pre-bet period, and somewhat greater separation in the post-bet period, the strongest separation, as expected, occurs between the two curves during the post-result period. This is when the participant experiences whether they won or lost their bet. This attests to the validity of the protocol and the participants' emotional engagement in the experiment.

The graphs in the bottom half of Figure 6 show the mean pattern of the recordings for beat-to-beat heart rate in the three sessions. There is clear evidence of separation between the win and loss curves in all three time-frames during the experiment. Of interest is the strong separation in both pre-stimulus periods, especially in Sessions 3 and 7, where a large separation between the HRV curves for wins and losses is evident. This is notable, because this is the period before the computer randomly selects the outcome, and the data suggest clear evidence of an intuitive effect begins some *12-14 seconds before* the betting result is presented to the participant. Moreover, this pre-stimulus effect appears to remain relatively consistent and stable over time. There is also evidence of reasonable separation between the heart rate variability win/loss curves in both the post-bet period and also for the post-result period; the latter is evidence of the participant's emotional engagement and indicates that the experiment was valid.



† p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Figure 6. Grand Average (All Subjects; N = 12) of Physiological Recordings for Non-entrepreneurs for Sessions 1, 3, and 7, During the Pre-Bet, Post-Bet, and Post-Result Segments

Table 2 presents the results of a random permutation analysis (RPA) across all 12 subjects. Despite the small sample size (N = 9-11/sessions), some statistically significant separations are observed between the win and loss curves for the skin conductance recordings (Session 1: pre-bet period, $p < 0.04$; post-result period, $p < 0.05$. Session 3: post-result period, $p < 0.001$. Session 7: post-result period, $p < 0.01$). There were also significant findings for heart rate variability win/loss curves, two of which were in the pre-stimulus period of Session 3 and Session 7 (Session 1: post-result period, $p < 0.01$. Session 3: pre-bet period, $p < 0.05$; post-bet period, $p < 0.10$; post-result period, $p < 0.01$. Session 7: pre-bet period, $p < 0.05$; post-result period, $p < 0.05$). Overall, in relation to physiological measures of an intuitive effect (the pre-bet period), the results of the RPA show more evidence of a consistent intuitive ability over time in the heart rate variability recordings than for skin conductance. This is consistent with the results of previous studies.

Table 2. Results of Random Permutation Analysis* (Aggregated Data for All Subjects) of Physiological Measures for Non-Entrepreneurs for Sessions 1, 3, and 7 by Segment

		Pre Bet		Post Bet		Post Result	
Session #	N	Stoffer Z	*p* <	Stoffer Z	*p* <	Stoffer Z	*p* <
Skin Conductance							
1	11	-1.705	0.05	-0.663	ns	1.861	0.05
3	10	-0.703	ns	0.262	ns	3.237	0.001
7	9	0.042	ns	0.781	ns	2.487	0.01
Heart Rate Variability							
1	11	0.872	ns	-0.198	ns	-2.458	0.01
3	10	1.993	0.05	1.468	0.1	-2.628	0.01
7	9	2.173	0.05	0.760	ns	-2.029	0.05

*α Based on 1,000,000 permutations

DISCUSSION AND LIMITATIONS

In reading our discussion of the results, the reader should know that certain limitations became apparent with both protocols in the repeat entrepreneur experiment (described below) which resulted in improvements to the Roulette protocol before it was used in the non-entrepreneur experiment.

Discussion

The results of both pilot experiments are promising. For the repeat entrepreneur experiment, the clear separation in the win/loss curves measuring changes in heart rhythm activity in the aggregated data for the Roulette experiment, show that informational input was received by the autonomic system some *6 to 7 seconds before* the outcome of the investment choice was known. This is consistent with previous findings from a rigorous experiment, involving a much larger sample of non-entrepreneurs in a controlled laboratory setting, where it was found that the heart receives pre-stimulus information approximately 6 seconds prior to a future event (McCraty et al., 2004a & 2004b). Results from the random permutation analysis of individual recordings found five instances, involving four entrepreneurs, in whom the physiological measures had significant or marginally significant predictive power in discriminating the entrepreneur's future win/loss

outcomes. Overall, there is compelling evidence that electrophysiological measures are promising and appear able to detect intuitive perception of a future outcome in repeat entrepreneurs.

For the non-entrepreneur experiment, measurement discrimination between the wins and loss curves in the aggregated physiological data appear valid and robust, as confirmed by the random permutation analysis, which, as already noted, is a highly conservative statistical procedure. The RPA results are strong and compelling evidence of measurement of nonlocal intuition, especially by the heart rhythm measures which show a pre-bet pre-result response to the future outcome some *12-14 seconds before* the result was made known to the participant. While this is even earlier than that found in previous research—typically 4 to 7 seconds, how much earlier the body responds to the future event before the event is manifest and known needs investigation.

A major concern of the non-entrepreneur study was the degree to which a nonlocal intuitive effect, as detected by electrophysiological measures, remains stable over time. While we are still completing the analysis of the repeated measures by individual, the aggregated results are very promising. It is important to establish the session to session variability in order to determine if other factors, such as baseline affective state, environmental factors, socio-emotional fields, etc., can affect intuitive ability. Subject to the complete results across all eight sessions, the results from the first, third, and seventh sessions show relatively consistent patterns both by experimental segment (pre-bet, post-bet, and post-result) and also suggest that a nonlocal intuitive effect appears present throughout the 8 repeated administrations of the experiment. If confirmed, this is a potentially important finding since there is some evidence from prior research that repeated administration of an experiment involving nonlocal information/interaction tends to produce a decline in the experimental nonlocal effect observed (see Jahn et al., 2003).

Finally, comparing the results for repeat entrepreneurs with those for the non-entrepreneurs is intriguing and has significant applied implications. This is because the sample of non-entrepreneurs had been practicing emotional coherence-building techniques specifically designed to develop and enhance intuitive ability, as described in Tomasino (2007). Although the skin conductance results for the entrepreneur sample are of questionable value, there are comparable positive results in the heart rhythm data for both entrepreneurs and non-entrepreneurs. To the degree that future research can link emotional management techniques, such as HeartMath's, with the enhancement of nonlocal intuitive ability, it may well be possible to train entrepreneurs and other professionals to develop their intuitive ability even further (Tomasino, 2007).

Limitations

As noted above, the repeat entrepreneur study was carried out on site in the Cambridge Technopol, using portable equipment and administered in a field setting—the participant's office or home.[6] Unfortunately, the equipment used did not allow for real time monitoring the raw physiological data as it was being recorded. This resulted in incomplete or missing data in the records from seven of the seventeen participants and reduced the number of usable cases to a marginal statistical level. This was not an issue in the non-entrepreneur experiment where we used standard laboratory equipment which provided for real time monitoring of data collection, and conducted the study under tightly controlled conditions.

[6] This required the experimenter to be present throughout the experiment to answer any participant questions and to monitor the function of the computer and electrophysiological data recording equipment.

A second limitation was the presence of the experimenter in the repeat entrepreneur experiment. While necessary in the out-of-country field conditions under which the study was conducted, there is some evidence documenting an experimenter artifact which can inhibit or even suppress a nonlocal effect (Radin, 1997; Tiller et al. 2001). This was not an issue in the non-entrepreneur experiment, since the study was conducted in a controlled laboratory setting without the presence of the experimenter or any research staff.

With respect to the Business Case protocol, aside from pretests, this was the first time the protocol was used for research. An issue which may have affected the repeat entrepreneur results is the experimenter's observation that the participants tended to over think the experiment's stimulus—the business case profile. Such a heavy reliance on cognitive processing would be likely to mask the psychophysiological processes—in particular, emotional response—we were measuring in order to predict the outcome of the future event. We have taken measures to reduce the participant's cognitive response in redesigning the stimulus in the Business Case experiment for future research.

CONCLUSION

In this work we have reported the results of two pilot experiments investigating the phenomenon of nonlocal intuition—that part of intuitive perception that is not based on reason or memory of past experience. One was conducted on a small sample of repeat entrepreneurs and the second on a somewhat larger sample of non-entrepreneurs who had been practicing emotional management techniques for a decade or more. Designed to test the efficacy of two new experimental protocols for studying nonlocal intuition in entrepreneurs and non-entrepreneurs, the results from both experiments are promising. For the aggregated data, the separation between the win/loss curves for the electrophysiological measures provide compelling evidence that the instrumentation appears effective in detecting intuitive perception of a randomly selected future event. And for the repeat entrepreneurs, the results of the analysis by individual, show clear evidence that physiological measures were able to detect an intuitive effect in four of the eight entrepreneurs.

Our working premise is that no matter how intuitive information is initially introduced into the psychophysiological systems, once received it is processed in the same way as information obtained through the familiar sensory systems (Bradley, 2006; McCraty, Atkinson, and Bradley (2004a). There is a substantial body of literature discussing the interpretation of cardiac decelerations/accelerations in relation to the processing of sensory information (e.g., Jennings & van der Molen, 2002; Lacey & Lacey, 1974; Van der Veen et al., 2001). However, to our knowledge, this is the first study to examine beat-to-beat changes in heart rate in the context of intuitive information processing amongst entrepreneurs. The results from this study constitute the first evidence that physiological measures of entrepreneurs' intuitive response are predictive of future outcomes. These findings are in broad terms consistent with a previous study of non-entrepreneurs which found that these physiological measures were able to predict emotionally arousing future events (McCraty, Atkinson, and Bradley, 2004a & 2004b).

The results from the Roulette protocol indicate that it appears useful as a generic stimulus for detecting nonlocal intuition in experiments on both entrepreneurs and non-entrepreneurs. Beyond our use of the protocol in a forthcoming large-scale study investigating intuitive perception of repeat entrepreneurs in three different countries (Australia, the UK, and the US) with an appropriate control group, it provides an experimental protocol for direct comparisons of nonlocal intuition among different populations. Moreover, the relatively stable results from the

repeated measures study suggest that the protocol is a reliable means of prompting physiological detection of a nonlocal intuitive effect.

In addition to verification of the nonlocal intuitive effect in large-scale studies of entrepreneurs, an important issue for future research is the relationship between cognition and physiology: the relationship between the entrepreneur's intuitive perception of the physiological predictors of a future event—such as a prospective business opportunity—and the outcome from his/her investment decision. This issue is one of the topics pursued in our large-scale study in which we also investigate whether the win/loss ratio can be improved by training entrepreneurs to become more aware of the sensory input from their feelings and emotions, using techniques like those described by Tomasino (2007).

A further important matter for future research is the effect of the social context on nonlocal intuition. As described elsewhere (Bradley, 2007; Bradley, Gillin, & Tomasino, 2009), it is likely that the intuitive ability of entrepreneurs and non-entrepreneurs alike is enhanced or inhibited by the degree to which relations in the group are socio-emotionally coherent. Regular interaction within a socio-emotionally coherent group should amplify the harmonic resonance of the group's bio-emotional energetic field with the energetic field of the object of attentional interest. This, in turn, will strengthen the signal the individual receives from the field of nonlocal intuitive information. It is expected that this will produce stronger intuitive ability than when the individual is alone. However, in groups permeated with relational discord and/or conflict, the dissonance of the collective energetic field will tend to disrupt or impede the individual's attentional interest and thereby weaken the energetic connection to the nonlocal object.

Overall, both the phenomenon of nonlocal intuition and the physiological instrumentation necessary to study it offer an entirely new way of approaching the question of entrepreneurship. Rather than being in opposition to the cognitive perspective currently popular, we believe this novel approach is complementary. In addition to offering rigorous new methods and procedures to complement the more traditional measurement and data collection techniques of social science, it also offers an expanded concept of rationality (Bradley, Gillin, & Tomasino, 2009; Bradley & Tomasino, 2009). For in addition to entrepreneurial decision/action based on reason and the accumulated wisdom of prior experience, there is also the rationality derived from the body's objective sensing of real events and opportunities that are remote in space or ahead in time.

REFERENCES

Agor, W. (1984), *Intuitive Management: Integrating Left and Right Brain Skills*, Prentice Hall, New Jersey.

Allison, W. C., & J. Hayes (1966), The cognitive style index: a measure of intuitive analysis for organizational research, *J. of Management Studies,* 1: 119-135.

Allinson, W. C., E. Chell, & J. Hayes (2000), Intuition and entrepreneurial behaviour, *European Journal of work and Organizational Psychology*, 9(1): 31-43.

Assagioli, R. (1971), *Psychosynthesis.* New York: Viking.

Barnard, C. (1938) *The Functions of the Executive*. Cambridge: Harvard University Press.

Baron, R. A. (2004) The cognitive perspective: a valuable tool for answering entrepreneurship's basic "why" question, *Journal of Business Venturing*, 19 (2): 221-239

Baron, R. E. (2004). Opportunity Recognition: Insights from a Cognitive Perspective, in Butler, J. E. (ed), *Opportunity and Entrepreneurial Behavior*, pp. 47-72. Information Age Publishing, CN.

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

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.

Bierman, D. J., & 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.

Blair, R.C., & Karniski, W (1993). An alternative method for significance testing of waveform difference potentials. *Psychophysiology*, 30: 518-524.

Blasband, R. A. (2000), The ordering of random events by emotional expression, *JSE,* 14: 195-216.

Bradley, R. T. (2006), Psychophysiology of entrepreneurial intuition: A quantum-holographic theory. In M. Gillin (ed.), *Regional Frontiers of Entrepreneurship Research 2006*, pp. 163-183. Australian Graduate School of Entrepreneurship, Swinbourne University of Technology, Hawthorne, Australia.

Bradley, R.T. (2007), Psychophysiology of intuition: A quantum-holographic theory of nonlocal communication. *World Futures: The Journal of General Evolution*, Vol. 63(2), 61-97.

Bradley, R.T. (2009: in press), Passionate attention and the psychophysiology of entrepreneurial intuition: A quantum-holographic theory. *International Journal of Entrepreneurship and Small Business.*

Bradley, R. T., & D. Tomasino (2009: in press), Entrepreneurial passion and the psychophysiology of intuitive action: A quantum-holographic approach. In L. P. Dana (ed.), *Encyclopedia of Entrepreneurship*.

Bradley, R.T., M. Gillin, & D. Tomasino (2009: in press), Transformational dynamics of entrepreneurial systems: Holographic processes and the organizational basis of intuitive action. *International Journal of Entrepreneurship and Small Business.*

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

Bradley, R.T., R. McCraty, M. Atkinson, & M. Gillin (2009a: in press), Nonlocal Intuition in Entrepreneurs and Nonentrepreneurs: An Experimental Comparison Using Electrophysiological Measures, in *Regional Frontiers of Entrepreneurship Research 2008,* AGSE, Swinbourne University of Technology, Hawthorne, Australia.

Brockhaus, R. H. & Horwitz, P. S. (1985). The Psychology of the Entrepreneur, in D. L. Sexton & R. W. Smilor (Ed.) *The Art and Science of Entrepreneurship.* Cambridge. MA: Ballinger.

Craig, J. & Lindsay, N. (2001), Quantifying "gut feeling" in the opportunity recognition process, *Frontiers of Entrepreneurship Research*, vol., pp. 124-135.

Don, N. S., McDonough, B. E., & 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.

Fiet, J. O., C. G. H. Van, et al. (2004). Systematic Search by Repeat Entrepreneurs. Connecticut, Information age publishing.

Fowler, H.W., & F.G. Fowler, eds. (1964), *The Concise Oxford Dictionary*, Oxford, England: Oxford University Press, 1964.

Gabor, D. (1946), Theory of communication, *Journal of the Institute of Electrical Engineers*, 93: 439-457.

Gartner. W. B. (1986). Who is the Entrepreneur? Is the Wrong Question. *Am. J. of Small Business.* Spring:11-32.

Gillin, M., F. LaPira, R. McCraty, R.T. Bradley, M. Atkinson, D. Simpson, & P. Scicluna (2007), Before cognition: The active contribution of the heart/ANS to intuitive decision making as measured in repeat entrepreneurs in the Cambridge Technopol, in *Regional Frontiers of Entrepreneurship Research 2008,* AGSE, Swinbourne University of Technology, Hawthorne, Australia.

Hahn, U. & Chater, N. (1997), *Concepts and Similarity,* MIT Press, Cambridge, MA.

Hogarth, R. M. (2001), *Educating Intuition*, University of Chicago Press, Chicago, IL.

Keh, T. H, Foo, D. M, & Lim, C. B. (2002), Opportunity Evaluation under Risky Conditions: The Cognitive Processes of Entrepreneurs, *Entrepreneurship: Theory & Practice,* Winter: 125-148.

La Pira, F., & M. Gillin (2006), Non-local intuition and the performance of serial entrepreneurs. *Int. J. of Entrepreneurship and Small Business*, Vol. 3, No. 1.

La Pira, F., M. Gillin and Scicluna, P, (2006). Non-local Intuition: Developing Electro-physiological Measures for Decision-Making Serial Entrepreneurs. 3rd AGSE-International Entrepreneurship Research Exchange, Australian Graduate School of Entrepreneurship, Unitec, Auckland, New Zealand.

Laughlin, C. (1997), The nature of intuition: a neuropsychological approach, in R. Davis-Floyd & P. S. Arvidson (eds.), *Intuition: The Inside Story*, pp. 19-37, Routledge, London.

Larsen, A. & Bundesen, C. (1996). A template matching pandemonium recognises unconstrained handwriten characters with high accuracy, *Memory and Cognition* Vol 24, p.136-143.

Levin, J., & J. Kennedy (1975). The relationship of slow cortical potentials to psi information in man. *J. of Parapsychology*, 39:25-26.

Lieberman, M. D. (2000), Intuition: a social and cognitive neuroscience approach, *Psychological Bulletin*, Vol 126, 1: 109-137.

Marcer, P., & W. Schempp (1997), Model of the neuron working by quantum holography, *Informatica*, 21: 519-534.

Marcer, P., & W. Schempp (1998), The brain as a conscious system, *International Journal of General Systems*, 27: 231-248.

May, E., Paulinyi, T., and Vassy, Z. (2005) Anomalous anticipatory skin conductance response to acoustic stimuli: experimental results and speculations about a mechanism. *The Journal of Alternative and Complementary Medicine*, 11 (4), 695-702.

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

McCraty, R., & Atkinson, M. (2003). Roulette Experiment Proctocol. Unpublished computer program. HeartMath Research Center, Institute of HeartMath, Boulder Creek, CA.

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

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

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

McDonough, B. E., Don, N. S., & 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, R.K. (2005). *Tuning up the value creation engine: On the road to excellence in International Entrepreneurship Education*. In J.A. Katz & D.A. Shepherd (Eds.), Advances in entrepreneurship, firm emergence and growth: Vol. 8. Cognitive approaches to entrepreneurship research (pp. 185-248). Greenwich, CT: JAI Press.

Mitchell, R.K., Smith, J.B., Morse, E.A., Seawright, K., Peredo, A.M., & McKenzie, B. (2002). Are entrepreneurial cognitions universal? Assessing entrepreneurial cognitions across cultures. *Entrepreneurship Theory and Practice*, 26(4), 9-32.

Mitchell, J. R., Friga, P. N. & Mitchell, R. K. (2005), Untangling the Intuition Mess: Intuition as a Construct in Entrepreneurship Research, *Entrepreneurship Theory & Practice,* Nov. pp. 653-679.

Mitchell, R.K., Busenitz, L., Lant, Bird, B,Gaglio, C. M, McMullen, J S, Morse, A, Brock Smith, J (2007). The Central Question in Entrepreneurial Research, *Entrepreneurship Theory and Practice*, 31(1), 1-27.

Mitton, D. G., (1989). The Compleat Entrepreneur, *Entrepreneurship Theory & Practice,* 13 (3): 9-19.

Myers, D. G. (2002), *Intuition: Its Powers and Perils*, Yale University Press, New Haven, CT.

Norretranders, T, (1995), *The User Illusion: Cutting Consciousness Down to Size.*Penguin Press Science, London

Pribram, K. H. (1991), *Brain and Perception: Holonomy and Structure in Figural Processing*, Lawrence Erlbaum Associates, Hillsdale, NJ.

Radin, D. I. (1997a), *The Conscious Universe: The Scientific Truth of Psychic Phenomena*, HarperEdge, San Francisco, CA.

Radin, D. I. (1997b), Unconscious perception of future emotions: an experiment in presentiment, *Journal of Scientific Exploration*, 11: 163-180.

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

Radin, D. I., & R. D. Nelson (1989). Evidence for consciousness-related anomalies in random physical systems. *Foundations of Physics*, 19: 1499-1514.

Shane, S. & Venkataraman, S. (2000). The promise of Entrepreneurship as a Field of Research, *Acad. of Manag. Review,* 25: #1, 217-226.

Shapero, A 1975 'The Displaced Uncomfortable Entrepreneur' *Psychology Today* Vol. 8 83-88

Simon, H. A. (1983). *Reason in Human Affairs*, Oxford: Blackwell

Simon, H. A. (1987). Making management decisions: the role of intuition and emotion, *Acad. of Management Executive*, 1 (1): 57-65.

Spottiswoode, S.J., and May, E.C.P. (2003) Skin conductance prestimulus response: analyses, artifacts and a pilot study. *Journal of Scientific Exploration*, 17, 617-647.

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

Tiller, W. A. (1997). *Science and Human Transformation: Subtle Energies, Intentionality and*

Consciousness. Pavior Publishing, Walnut Creek, CA.
Tiller , W. A., Dibble, W. E. & Kohane, M. J., (2001) *Conscious Acts of Creation: The Emergence of a New Physics*, Pavior Publishing, Walnut Creek, California.
Tomasino, D. (2007), The psychophysiological basis of creativity and intuition: accessing 'the zone' of entrepreneurship, *Int. J. of Entrepreneurship and Small Business*, 4 (5): 528-524.
Tressoldi, P.E., Martinelli, M., Zaccaria, E., and Massaccesi, S. (2009) Implicit intuition: how heart rate can contribute to prediction of future events. *Journal of the Society for Psychical Research*, Vol. 73.1, No. 894, 1-16.
Walach, H., & S. Schmidt (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., B. E. McDonough, & N. S. Don., (1992a), Event-related brain potential changes in a psi task, *Journal of Parapsychology*, 56: 1-30.
Warren, C. A., B. E. McDonough, & N. S. Don., (1992b), Partial replication of single event-related potential effects in a psi task, *J. of Parapsychology*, 56: 1-30.

APPENDIX

Hardware: Repeat Entrepreneur Experiment

The inter-beat Heart Rate & DC skin conductance module (data logger) was designed and constructed by Dr. David Simpson from the Brain Sciences Institute. The Random Number Generator is an Araneus Alea 1, which provides high quality, unbiased and uncorrelated random numbers that pass a number of stringent statistical tests including the Diehard and NIST test. All recordings were performed using 3M brand Red Dot® EKG Littman electrodes. DC Skin Conductance (SC) was detected using electrodes attached to the pads of the participant's index and second fingers of the non-dominant hand. SC measurements were performed using current limited 0.5Volts DC excitation. The ECG was detected using a standard lead-one configuration. A band-limited differential amplifier detected the QRS waveform of the ECG. All between-beats-heart-rate (BBHR) measurements were timed using a micro-processor based system. The resultant SC and BBHR measurements were passed to a monitoring computer system via a 6kV isolated RS232 interface (to AS3551:2004).

Hardware: Non-Entrepreneur Experiment

A Biopac MP30 was used to record the ECG and skin conductance data. All recordings were performed using disposable ECG electrodes. DC Skin Conductance levels (SCL) was measured using disposable electrodes attached to the pads of the participant's index and second fingers of the non-dominant hand. Data processing and statistical analysis were performed using DADISP and SPSS software. The Random Number Generator was an Araneus Alea 1, which provides high quality, unbiased and uncorrelated random numbers that pass a number of stringent statistical tests, including the Diehard and NIST test.