PERSONALITY CORRELATES TO ELECTROPHYSIOLOGICAL MEASURES OF PRESTIMULUS RESPONSE

by

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Abstract

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This study assessed personality correlates to electrophysiological measures of prestimulus response (PSR). PSR is the body's response to a future stimulus prior to experiencing the stimulus. PSR may be an approach to measuring an aspect of intuition. One-hundred candidates for the study completed the Myers-Briggs Type Indicator (MBTI). Data were scored to generate raw points and to categorize each participant by 4 of 8 MBTI personality factors. Forty-two participants consisting of 21 people with the highest respective scores on the MBTI Intuition and Sensation scales were selected for inclusion in the study. Electrophysiological data were acquired during a PSR experiment utilizing a roulette simulation. The participants were connected to a Biopac MP150® data acquisition system to continuously acquire electrocardiogram (ECG) for heart rate variability (HRV) and skin conductance levels (SCL). In each of 26 trials, the participants made a simulated investment and chose either red or black as the future target. Once the electrophysiological data were acquired, the target was determined by a random number generator. For each participant, HRV and SCL were analyzed separately for win and loss trials for 3 segments of each trial—prebet, postbet, and postresults. Random permutation analysis was used to determine statistical significance of the differences for HRV and SCL respectively for win and loss trials. Stouffer *Z* scores were calculated for participants categorized to the 8 personality factors in order to determine which personality factors, if any, correlated with electrophysiological evidence of PSR. Participants categorized as Sensation on the MBTI demonstrated a significant HRV response to prestimulus information in the prebet

segment ($N = 19$, $Z = -1.83$, $p = .0333$). SCL evidence of prestimulus response was not statistically significant. The results of this study may be applicable to areas of business, learning, overall well-being, creativity, medical diagnosis, healing, and spiritual growth.

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Chapter 1: Introduction

Research Question

The purpose of this study was to explore the question, "Do characteristics of personality correlate to electrophysiological measures of prestimulus response (PSR), and if so, which ones?" PSR is the body's response to a future stimulus prior to experiencing the stimulus. The emotional significance of the future stimulus is often reflected in PSR; the greater the emotional significance of the future stimulus the larger the physiological response prior to experiencing the stimulus.

PSR may be an approach to measuring an aspect of intuition. There is a plethora of research on intuition; however, there is not a consensus about a definition or theory of intuition (Agor, 1984; Assagioli, 1990; Bailey, 1978; Berne, 1949; Bradley, 2007; Govinda, 1969; Hogarth, 2001; Jung, 1933; Laughlin, 1997; Liester, 1996; McCraty, Atkinson, & Bradley, 2004a, 2004b, in press; McLean, 1978; Torff & Sternberg, 2001; Vaughan, 1973; Weil, 1972; Wild, 1938).

McCraty et al. (2004b) regarded "nonlocal 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 system. Experiences of intuition may occur in many forms. McCraty et al. explained that "the experience of intuition is not confined to cognitive-based perception, but involves the entire psychophysiologic system, often manifesting through a wide range of emotional feelings and physiologic changes experienced through the body" (p. 326).

PSR may be a form of intuitive perception. Bradley (2007) described intuitive perceptions as "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" (p.

61). In PSR studies, the body's apparent foreknowledge of the future is detected and measured by electrophysiological instruments.

There is a large body of research showing electrophysiological evidence of PSR (Bierman, 2000; Bierman & Radin, 1997, 1998; Bierman & Scholte, 2002; Bierman & van Ditzhuijzen, 2006; Don, McDonaough, & Warren, 1998; Gillin et al., 2007; Hinterberger, Studer, Jäger, Haverty-Stacke, & Walach, 2006; La Pira & Gillin, 2006; La Pira, Gillin, & Scicluna, 2006; Levin & Kennedy, 1975; McCraty et al., 2004a, 2004b, in press; McDonough, Don, & Warren, 2002; May, Paulinyi, & Vassy, 2005; May & Spottiswoode, 2003; Norfolk, 1999; Paige, Newton, Reese, & Dykman, 1987; Parkhomtchouk et al., 2002; Radin, 1997a, 1997b, 2004; Radin & Lobach, 2007; Spottiswoode & May, 2003; Warren, McDonough, & Don, 1992a, 1992b; Wildey, 2001). However, not all participants in PSR studies show individual electrophysiological evidence of PSR. If personality characteristics, for instance, Intuition on the Myers-Briggs Type Inventory, correlate with PSR electrophysiological data, then personality instruments may be used to inform the selection of participants in future PSR studies.

Significance of Research

Studying PSR is relevant to virtually every aspect of our lives. By studying electrophysiological responses to information about future events before these events actually take place, we may be able to use our body's electrophysiological responses to inform choices and decisions in business, learning, overall well-being, creativity, medical diagnosis, healing, and spiritual growth. Studying the correlation of personality characteristics to electrophysiological measures of PSR may inform the selection of participants in future studies of PSR and the selection of people for roles that may benefit from having information about future events before these events actually take place.

Overview of Study Design and Analysis of Results

The following procedure was used to assess the correlation of personality characteristics to electrophysiological measures of PSR. A personality measure, the Myers-Briggs Type Indicator (MBTI) Form M, was administered to a pool of 100 candidates for the study. The MBTI data were hand scored using the procedure described on the Form M scoring templates to generate raw points for the eight factors (namely, Extrovert, Introvert, Intuition, Sensation, Thinking, Feeling, Judging, and Perceiving) and to categorize each participant by 4 of the 8 personality factors. Forty-two participants consisting of 21 people with the highest respective scores on the MBTI Intuition and Sensation scales were selected for inclusion in the study. The dichotomous preferences, Intuition and Sensation, were selected because PSR may be a measure of an aspect of intuition.

Electrophysiological data were acquired during the following PSR experiment utilizing a roulette simulation developed and tested by the Institute of Heart Math (Gillin et al., 2007; La Pira & Gillin, 2006; La Pira et al., 2006; McCraty et al., in press). The participants were connected to a Biopac MP150® data acquisition system (McMullen & Kremer, 2007) to continuously acquire electrocardiogram (ECG) for heart rate variability (HRV) and skin conductance levels (SCL). HRV is a measure of the beat-to-beat changes in heart rate. SCL is a measure of the electrical conductance of the skin. In each of 26 trials, the participants made a simulated investment and chose either red or black as the future target. After electrophysiological data were acquired, the target was determined by a random number generator. The result of each run was tallied on the bottom left-hand side of the screen so that the participant received feedback and knew whether she or he won or lost on each trial. A running total (win/loss) was also displayed on the screen.

For each participant, HRV and SCL were analyzed separately for win and loss trials for three segments of each trial—prebet, postbet, and postresults. Random permutation analysis was used to generate *z*-scores to determine statistical significance of the differences in HRV and SCL respectively in win and loss trials. Stouffer *Z* scores were calculated for participants categorized to the eight personality factors of the MBTI in order to determine which personality factors, if any, correlated with electrophysiological evidence of PSR. Further analysis was conducted based on gender and age of the participants (see Chapter 4).

Overview of Dissertation

This dissertation is divided into four subsequent chapters. Following this introductory chapter, Chapter 2 offers an overview of the PSR studies as delineated in the available literature. Following the literature review, Chapter 3 describes the details of the research methods used, including the rationale for the overall design, a description of the participants, the instruments used, the procedures for data acquired, and the analysis techniques. Chapter 4 presents the results of this study. Finally, Chapter 5 concludes this dissertation with a discussion that integrates data, describes limitations and delimitations, and provides suggestions for future research.

Chapter 2: Literature Review

Overview of Literature on Prestimulus Response

This chapter provides an overview of the history of PSR studies and an overview of measures of paranormal beliefs and experiences. The PSR studies in this review use several measures (see Table 1); however, for organization, they will be divided into four subsections: studies using event related potentials (ERP), skin conductance levels (SCL), functional magnetic resonance imaging (fMRI), and heart rate variability (HRV). The literature will be reviewed chronologically within each subsection. This will be followed by a review of theoretical literature relevant to PSR and an overview of measures of paranormal beliefs and experiences.

Prestimulus Response Studies

Prestimulus response studies using event related potentials. Levin and Kennedy (1975) were the first researchers to publish physiologic evidence of PSR in a peer reviewed journal. Levin and Kennedy acquired electroencephalogram (EEG) to measure event related potentials (ERP) in a pilot study to determine whether people use psi information in neural processing to prepare for voluntary motor responses. ERP are voltage fluctuations that are associated in time with some physical, mental, or emotional occurrences and can be recorded from the scalp. ERP have measurable components such as negative slow waves (NSW). On each trial, an amber warning light preceded either a red or green light by 1.25 seconds. Five participants were instructed to press a key as quickly as they could when they saw a green light. Levin and Kennedy observed significantly larger NSW brain potentials associated with PSR, after the amber warning light, but before the randomly determined green light ($z = 1.96$, $p = .05$, two tailed).

Table 1

Measures Used in Prestimulus Response Studies

PSR Study Author, Date	BVP	ERP	fMRI	HR	HRV	ns-SCR	SCL
Bierman, 2000	X			X			X
Bierman & Radin, 1997	X			X			X
Bierman & Radin, 1998	X			X			X
Bierman & Scholte, 2002			X				
Bierman & van Ditzhuijzen, 2006		X					
Don, McDonaough, & Warren, 1998		X					
Gillin, LaPira, McCraty, Bradley, Atkinson, Simpson, & Scicluna, 2007				X	X		X
Hinterberger, Studer, Jäger, Haverty-Stacke, & Walach, 2006		X					
La Pira & Gillin, 2006				X	X		X
La Pira, Gillin, & Scicluna, 2006				X	X		X
Levin & Kennedy, 1975		X					
May, Paulinyi, & Vassy, 2005						X	
May & Spottiswoode, 2003						X	
McCraty, Atkinson, & Bradley, 2004a		X		X	X		X
McCraty, Atkinson, & Bradley, 2004b		X		X	X		X
McCraty, Atkinson, & Bradley, in press				X	X		X
McDonough, Don, & Warren, 2002		X					
Norfolk, 1999		X					
Paige, Newton, Reese, & Dykman, 1987		X					
Parkhomtchouk, Kotake, Zhang, Chen, Kokubo, & Yamamoto, 2002	X			X			X
Radin, 1997a	X			X			X
Radin, 1997b	X			X			X
Radin, 2004	X			X			X
Radin & Lobach, 2007		X					
Spottiswoode & May, 2003						X	
Warren, McDonough, & Don 1992a		X					
Warren, McDonough, & Don 1992b		X					
Wildey, 2001		X					

Note. BVP = blood volume pulse; ERP = event related potentials; fMRI = functional magnetic resonance imaging; HR = heart rate; HRV = heart rate variability; ns-SCR = nonspecific skin conductance response; SCL = skin conductance level.

Levin and Kennedy's (1975) findings were supported by an unrelated Pavlovian conditioning study. Paige, Newton, Reese, and Dykman (1987) reported significant PSR ERP in 10 male medical students (mean age = 26 years, range = 24 to 28 years) in the habituation phase of a conditioning experiment. The medical students showed a significantly larger P300 (an ERP component) prior to conditioned stimuli before they had any way of knowing which of two stimuli (conditioned or unconditioned) would be later presented.

In two separate studies Warren et al. (1992a, 1992b) reported significant prestimulus ERP changes in Malcolm Besset during computerized PSR trials using targets selected by a random number generator. Besset is an exceptional participant who has shown above-chance performance in other published laboratory psi tasks (see Honorton, 1987). Besset was administered 200 self-paced trials (20 runs with 10 trials per run). On each trial, Besset was shown four card images on a computer monitor 2.5 seconds after being presented with the last four card images. Besset then selected one of the card images using a game paddle to move the cursor on the screen and registered his guess using the paddle enter key. Once he made the selection, the target image was randomly chosen by the computer among the four card images and displayed on the monitor.

Besset was instructed to inhibit his eye-blinks and movements as well as his body movements during the stimulus presentation sequence for each trial and to attempt to blink during other less critical portions of the trial or between trials. Besset was permitted rest breaks and allowed to smoke at will.

Besset showed larger PSR in two ERP components, P100 and the NSW, to targets than nontargets (Warren et al., 1992a). The significantly larger P100 and NSW were widely distributed across all 10 scalp sites examined by the investigators. The P100 and NSW accounted

for two-thirds of the variance in a significant, successfully cross-validated, multiple regression model predicting target-nontarget status. However, in his conscious guesses Besset scored nonsignificantly below chance level in the 200 self-paced trials over a 1⅔ hour period. The investigators concluded that PSR is unconscious because information is not consciously available to improve guessing accuracy. Possible explanations for below chance performance not discussed by the investigators include habituation, decrease in motivation, and fatigue.

Warren et al. (1992b) partially replicated their first study using exactly the same protocol. Consistent with the preliminary findings, prestimulus response NSW were significantly larger to targets than nontargets. However, the significantly larger prestimulus response NSW only occurred at the five left-hemisphere scalp sites examined in the study. Also consistent with the preliminary findings, Besset's correct guesses were nonsignificantly below chance. The investigators suggested that Besset's performance may have been due to increased demands associated with the need to control eye movements and with the distractive effect of having electrodes attached to his scalp. The significant P100 findings reported in the first study could not be replicated.

The preceding prestimulus response NSW findings were extended in two subsequent gambling studies with participants who were not selected for self-reported psychic ability or experience (Don et al., 1998; McDonough et al., 2002). Each participant was selected for self-report of gambling activity at least once a week. In the first gambling study, 25 participants (17 male and 8 female, mean age = 27.4 years, range = 18 to 49 years) were given 80 trials similar to those in the preceding studies. The study utilized a crossover design; half of the 80 trials used in the study were "nonwager trials" (each participant played just for fun) and in the other half each participant wagered 50 cents per hand, with a $2 possible payoff per hand.

Don et al. (1998) observed significantly larger PSR in NSW over the left hemisphere to targets than nontargets in nonwager trials ($F = 7.33$, $p = .007$, one-tailed), and a very early negativity peaking at about 59-67 ms in both "nonwager" and "wager" trials ($F = 5.26$, $p = .03$). NSW were found to be approximately similar in size and direction over both (left and right) hemispheres; at the same time, the right hemisphere data failed to reach statistical significance. The investigators mentioned that the nonsignificant tendencies observed over the right hemisphere preclude conclusions about the involvement or noninvolvement of the right hemisphere.

Don et al. (1998) findings suggest that participants allocated more attentional resources to targets than they did to nontargets. Again, this possible allocation of attention did not appear to be a conscious process because it did not inform the participants. The participants' performance in the gambling task during nonwager trials was nonsignificantly below chance.

Guessing accuracy tended to be nonsignificantly above chance in the wager trials. Except for the very early negative peaking at about 59-67 ms, the NSW observed for targets in the nonwager trials did not occur in the wager trials. In fact, the ERP was slightly positive in the wage trials, suggesting that the act of wagering may affect prestimulus response ERP. Firm conclusions cannot be drawn from nonsignificant tendencies; however, it is possible that nonsignificantly positive prestimulus response ERP are associated with the nonsignificantly above chance correct guessing accuracy. This association may indicate that the participants in this study had a different motivational/attentional set in wager trials than in nonwager trials, which improved their ability to discriminate targets from nontargets (Don et al., 1998).

In the second gambling study, the investigators (McDonough et al., 2002) studied PSR in 20 participants (16 males, 4 females, mean age = 27.4 years, range = 18 to 49 years) who self-

reported gambling activity at least once a week. The protocol was similar to the first gambling study. Results were reported only for the nonwager trials. PSR was observed in significantly larger NSW for targets than for nontargets over the six sites examined in the right hemisphere ($F = 4.29$, $p \leq .05$), but not over the left hemisphere sites examined in this study. The investigators mentioned that it is possible that more than one type of NSW was elicited by the PSR task. Participants' guessing accuracy was nonsignificantly above chance.

Bierman and van Ditzhuijzen (2006) studied PSR in 32 participants (22 female, 10 male, mean age = 23 years, range = 17 to 51 years). Participants were students and could earn course credit or money or a combination. The amount of money they could earn was determined by the outcome of the slot-machine task. At the beginning of the experiment the participants received a loan of seven pieces of 50 eurocents. Participants were informed that they had to pay 50 cents for each trial and that the outcomes were random. The slot-machine was implemented using video clips. Each video clip contained a movie of a slot-machine with three windows with moving fruits. The participants had to press any key to initiate a trial and run the clip. The video clip to be presented was copied randomly when the participant initiated the trial from a prepared pool of 128 slot-machine video clips. One second after the participant pressed any key to initiate the trial, the left-most window froze to display one of three possible fruits. After another second the middle window froze into one of three possible fruits, and after another 1-second the last rightmost window froze into one of the three possible fruits.

There were three types of outcomes: three subsequent different fruits (XYZ), two equal fruits followed by a different one (XXY) and three equal fruits (XXX).The outcome where all three windows had equal fruits was a win and the experimenter paid the participants 14 pieces of 50 eurocents for each win. A priori probability for an XXX-event was 12.5% throughout the

experiment. Each participant completed 128 trials. The subjects kept the money they won and did not pay anything whenever they lost money.

The investigators compared the mean voltage during the one second preceding the outcome pooled from three mediofrontal electrodes. As in other studies showing evidence of PSR, the investigators expected that the brain signals preceding a win would differ significantly from the brain signals before a loss. PSR was confirmed by comparison of two types of outcomes, XXX and XXY, for the period from 1 to 2 seconds (at XX and before the last fruit is known). During this time there were no visible differences for the participants, even though the brain signals differed by about 1.9 microvolt on average ($t = 2.34$, $df = 31$, $p = 0.026$). The effect size was larger for males (~ 2.6 microvolt) than for females (~1. 5 microvolt) but the difference was not significant.

Radin and Lobach (2007) studied PSR in 20 participants (13 females, age = 18 to 65 years; 7 males, age = 48 to 65 years). The investigators recorded slow brain wave activity from the occipital region (associated with vision) at the back of their participants' brains via EEG while the participants were visually stimulated at random times. The stimulation came in the form of a light that was quickly flashed toward the subject's eyes through a pair of opaque glasses fitted with light-emitting diodes (LEDs). To start each individual test trial, the participant clicked a computer mouse that they held in their hands. After 4 seconds (which constituted the prestimulus period) had passed, the computer sampled a random number generator to determine whether it should activate the LEDs in the participants' glasses and produce a flash, or whether it should keep them dark until the end of the trial (indicated by a computer tone). The same process was then repeated for the next trial. One hundred trials were conducted per participant. The probability of the subject seeing the LEDs flash or not was exactly .50 for each trial.

Female participants showed evidence of PSR with a slightly higher level of brain wave activity in the prestimulus period on the trials where the LEDs were flashed than on the trials where the LEDs did not flash ($z = 2.72$, $p = 0.007$, two-tailed). The investigators found that the peak level of brain wave activity for the female participants occurred approximately 1-second before the light flash. For males, the same analyses were weakly negative, in that their level of brain wave activity was slightly lower on flash trials than on no flash trials ($z = -1.64$, $p = 0.10$, two-tailed). This latter finding was not statistically significant. However, the gender differences between outcomes were significant ($z = 3.08$, $p = .0002$, two-tailed) and warrant further research.

The strength of Radin and Lobach (2007) PSR study lies in its rigorous design and analysis, thereby providing results that are not caused by anticipatory strategies, equipment or environmental artifacts, or violation of statistical assumptions. A weakness in this study is the small sample size. The investigators mention that caution is warranted in generalizing the study findings.

ERP will not be used in the current study due to the amount of time and expertise required to acquire and analyze EEG and ERP data. In the current study, physiologic measures will be limited to HRV and SCL. SCL has been chosen as the second physiologic measure because of its frequent use in PSR studies. The next section summarizes the findings of studies showing SCL evidence of PSR.

Prestimulus response studies using skin conductance levels. Bierman and Radin (1997) observed significant prestimulus differential effects in skin conductance levels (SCL), heart rate (HR), and blood volume pulse (BVP) measures prior to presentation of emotional and neutral photographic stimuli.

In a series of four experiments (Radin, 1997b), 31 participants were asked to read an informed consent form explaining that some disturbing pictures might be shown and to provide their verbal consent before the PSR experiment began. Electrodes and photoplethysmograph were placed for recording SCL, HR, and BVP. Participants sat in a reclining chair approximately two feet in front of a computer monitor. Participants pressed a mouse button that started each trial. After the button press, the computer screen remained blank for 5 seconds, and then the computer randomly selected a target photograph which was displayed for 3 seconds. The target photographs were digitized color photographs from a pool of 120 photographs. Some target photographs labeled "calm" included landscapes and cheerful people; other target photographs labeled "extreme" included violent (mutilated bodies) and erotic topics (explicit sexual activity).

The 3-second presentation of the target photograph was followed by a blank screen for 5 seconds. This blank screen was then followed by a 5-second rest period. After the rest period, a message indicated that when the participant was ready to begin the next trial, the button could be pressed again. The participant viewed 41 pictures in a single session, one picture at a time. The experimenter observed the participant on the first trial to make sure that the procedure was followed correctly, while the remaining 40 trials were performed without any supervision. Only the last 40 trials were used in the analysis. SCL, HR, and BVP were continuously monitored throughout all of the trials.

The analysis was designed to take into consideration the fact that people have different baseline (tonic) levels and that electrophysiological measurements vary over time within individuals (Andreassi, 1989). Higher tonic levels of electrodermal activity are associated with increased attention and better vigilance on perceptual tasks. "Labiles," people with higher baseline tonic levels of electrodermal activity, manifest larger electrodermal responses to

emotionally significant stimuli (Prokasy & Raskin, 1973). Different underlying baselines were taken into account by taking the differences between the mean values of a given epoch and all of the individual samples in that epoch. The baseline mean per epoch was based on the electrophysiological values of the first 5 seconds of the epoch, before the display of the photograph. Analysis, based on the mean of all prestimulus reactions, showed a clear PSR that peaked with a four standard error difference in electrophysiological measures between extreme and calm targets 1 second before the target photograph was displayed. This supported Radin's (1997b) presentiment hypotheses that emotional shock caused by viewing an emotional picture in the future causes an unconscious physiologic "preaction."

Radin (1997b) informally interviewed each of the participants in his study. None of the participants reported any conscious awareness of the targets to be presented or any systematic electrophysiological differences before the presentation of the targets.

Radin's (1997b) study has been replicated by Bierman and Radin (1997, 1998), Bierman (2000), Parkhomtchouk et al. (2002), and Radin (2004). All of the replication studies showed results that support the presentiment hypothesis. As with Radin's first presentiment study in 1997, these studies have found that the magnitude of the results depends on the sample and on different methods of grouping pictures in calming/emotional categories.

The major strength of Radin's (1997b) presentiment study is the design, quantification, and hypothesis-testing capability. The design fits the gold standard for scientific research as a straightforward, transparent laboratory demonstration of psi that can be replicated by any competent experimenter, including a skeptical one, using participants drawn from the general population. Radin discussed and refuted alternative hypotheses that the results were due to

chance, cueing artifact, analysis artifact, targets being presented in a nonrandom order, and anticipatory effects.

A criticism of Radin's (1997b) study is that photographic stimuli elicit idiosyncratic responses. A picture that has been rated as having a high average affectivity may have a low affectivity for some individuals and vice versa. For example, people who fear snakes may show higher SCL in response to a photograph of a snake than an individual who enjoys snakes as pets. Idiosyncratic responses would also affect controls, so presumably any idiosyncratic reactions may cancel each other. The idiosyncratic responses to photographic stimuli could be identified by measuring the real time electrophysiological reaction after the photograph is shown. Categorizing pictures and then selecting a few pictures from each category to test for the degree of emotion generated by each participant prior to a PSR study can remedy this limitation.

Spottiswoode and May (2003) developed an experiment eliminating the possible confound that photographic stimuli elicit idiosyncratic responses. They replaced the emotional visual stimuli with acoustic startle stimuli of 97 decibels for 1 second, and they replaced the calm visual stimuli with silence for 1 second. Spottiswoode and May also simplified the analysis by declaring their dependent variable to be the difference of proportions of 3-second prestimulus intervals that contained fully formed nonspecific skin conductance responses (ns-SCR) prior to acoustic stimuli compared to prior silent controls. The null hypothesis was that the prestimuli proportions of intervals that contained fully formed ns-SCR should be equal for both the 1 second startle stimuli of 97 decibels and for the 1 second of silence.

Spottiswoode and May (2003) studied prestimulus ns-SCR in 125 participants (65 females, 60 males, ages ranging from 20 to 74 years). Spottiswoode and May found mean proportions of 0.099 for ns-SCR before acoustic stimuli and 0.064 before silent controls. Instead

of an expected null hypothesis ratio of 1.0 for ns-SCR, they found a ratio of 1.53 ($z = 2.84$, $ES = 0.086$, $p = 0.002$). The effect size was defined as the proportion z-score divided by the square root of the number of acoustic stimuli.

May et al. (2005) successfully replicated the two previous acoustic startle PSR studies. Their sample consisted of 50 self-selected participants (33 female, 17 male, mean age = 38.4 years, range = 17 to 74 years). However, May (2004) did not believe the primary hypothesis that individuals are responding in advance to acoustic startle stimuli. Instead, May et al. (2005) believed that experimenters use their own psi to initiate runs such that otherwise random ns-SCR from the experiment participant are sorted into appropriate preacoustic and precontrol bins to mimic electrophysiological responses. This sorts random, and nonresponsive, ns-SCR in order to mimic a precognitive response by psychically starting runs at the right time. The tendency exhibited by experimenters or individuals using psi to bias their general decision making toward favorable outcomes is referred to as decision augmentation (May, Utts, & Spottiswoode, 1995). The researchers suggested a prospective study to definitively assess decision augmentation.

Requiring the participants to press a button in order to initiate each trial is standard protocol in PSR studies using emotional/calm visual stimuli (Bierman, 2000; Bierman & Radin, 1997, 1998; Bierman & Scholte, 2002; McCraty et al., 2004a, 2004b; Norfolk, 1999; Parkhomtchouk et al., 2002; Radin, 1997a, 1997b, 2004; Wildey, 2001).

Prestimulus response studies using functional magnetic resonance imaging. Bierman and Scholte (2002) used fMRI to examine the neural substrates of presentiment. Ten participants consisting of 6 males and 4 females with a mean age of 27.2 years (SD = 10.9) were instructed to relax while passively looking via a mirror at 48 pictures. The pictures were either emotional (violent, erotic) or neutral and determined randomly with a priori chance of 2 neutral versus 1

emotional. Each trial started with a 4.2-second presentation of a fixation point before and during which the PSR was measured. Then a randomly selected emotion or neutral picture was presented for 4.2 seconds. This was followed by 8.2 seconds during which the participant was expected to recover from the possible emotional presentation.

The 6 male participants showed larger PSR (fMRI BOLD values) before the erotic stimuli ($td = 2.10$, $df = 226$, $p < .05$) compared with neutral pictures. The male participants did not show significant difference between violent and neutral PSR. The 4 female participants showed larger PSR (fMRI BOLD values) before both erotic pictures ($td = 1.75$, $df = 158$, $p < .05$) and violent pictures ($td = 1.99$, $df = 159$, $p < .05$) as compared to neutral pictures. Bierman and Scholte's (2002) results support the presentiment hypothesis by showing that PSR in the visual cortex is significantly larger preceding emotional stimuli than preceding neutral stimuli.

fMRI will not be used in the current study due to the amount of time and expertise required to analyze fMRI data. The next section summarizes the findings of studies that include HRV in addition to other electrophysiological evidence of PSR.

Prestimulus response studies using heart rate variability. McCraty et al. (2004a, 2004b) used ECG, SCL, and EEG to record PSR in 26 participants (11 males and 15 females, mean age = 45 years, range 28 to 56 years) who had prior training in HeartMath® techniques in order to assess the special and temporal flow of intuitive information and to test the hypothesis that an enhanced PSR is related to the maintenance of a state of physiological coherence. The HeartMath® techniques are a set of positive emotion refocusing and emotional restructuring interventions that reduce stress, promote health, and enhance performance (Childre & Martin, 1999; McCraty & Childre, 2002). Physiological coherence is associated with a sine wave-like pattern in the heart rhythms, increased heart/brain synchronization, and entrainment between

diverse physiological systems. Physiological coherence is a natural human state which can occur spontaneously during positive emotional experiences and sleep; however, sustained episodes are generally rare. While specific rhythmic breathing methods may induce coherence and entrainment for brief periods, the active generation and maintenance of a positive emotion can produce extended periods of physiological coherence.

McCraty et al.'s (2004a, 2004b) study design was similar to Radin's (1997b) presentiment study. Each trial began with participants viewing a computer screen. A message appeared on the monitor instructing the participant to begin the trial by pressing the mouse button when ready. The monitor remained blank for 6 seconds after the mouse button was pressed. Then the computer randomly selected either a calm picture or an emotional picture and displayed it for 3 seconds. A blank screen followed this for 10 seconds before displaying a message to begin the next trial when ready. Each participant viewed 45 pictures in each of the two conditions described within the next paragraph.

McCraty et al. (2004a, 2004b) used a counterbalanced crossed over design to control for exposure effects. One-half of the 26 participants completed the experimental protocol in condition one first and returned 2 weeks later to complete the experimental protocol in condition two. The second half of the 26 participants completed the experimental protocol in condition two and returned 2 weeks later to complete the experimental protocol in condition one. In condition one, participants were instructed not to engage in any meditative practice or HeartMath® technique prior to being exposed to randomly selected emotional and calm pictures. In condition two, participants were instructed to engage in Heart Lock-In, an emotional restructuring technique that combines intentional heart focus with self-generated genuine positive emotion,

such as appreciation, care, gratitude, or love for 15 minutes prior to being exposed to the randomly selected emotional and calm pictures.

McCraty et al. (2004a, 2004b) measured SCL, ECG to analyze HRV, and EEG to analyze ERP. They did not find significant changes in SCL in either of the two experimental conditions. This was likely due to the participant sample in this study. All participants were experienced practitioners of meditation and HeartMath® emotional management techniques. In their publication, the investigators reported a communication with Radin during which they were informed that Radin excludes people who meditate from his PSR studies because he has found that participants who meditate do not show the expected PSR in SCL measures.

McCraty et al. (2004a, 2004b) were the first researchers to show PSR in ECG measures analyzed for HRV. They reported significant differences in HRV between calm and emotional trials in condition one (z = -3.19, p = .0001) starting around 4.5 seconds before the pictures were displayed. In condition two, females demonstrated a significant HRV response to prestimulus information, whereas the males did not. This evidence suggests that females are more attuned to information from the heart, especially when the coherent mode is activated. The investigators also found significant differences in ERP over several scalp locations between calm and emotional trials in both conditions prior to the display of the pictures. These findings include the general location in the brain where prestimulus information is processed and show that prestimulus information from the heart is communicated to the brain (see McCraty et al., 2004b).

McCraty et al.'s (2004a, 2004b) electrophysiological observations provide compelling evidence that the heart independently, and prior to the brain, receives prestimulus information. Heart rate deceleration curves occurred approximately 4.8 seconds prior to the display of emotional pictures, whereas sharp positive shifts in the ERP occurred approximately 3.5 seconds

prior to the display of emotional pictures. As the investigators mentioned, evidence that the heart receives information independently from the brain is supported by findings in neurocardiology showing that the heart has an extensive intrinsic nervous system that can override inputs from the sympathetic and parasympathetic nervous systems (Armour, 2003; Armour & Ardell, 1994) and that the heart modulates a wide range of processes including reaction times (Lacey & Lacey, 1974), pain perception (Randich & Gebhart, 1992), electrodermal activity and cognitive functions (Rau, Pauli, Brody, & Elbert, 1993; Sandman, Walker, & Berka, 1982; van der Molen, Somsen, & Orlebeke, 1985), visual perception (Walker & Sandman, 1979, 1982), and the processing of perceptual and emotional information (Frysinger & Harper, 1990; McCraty & Childre, 2004; Sandman et al., 1982).

McCraty et al. (2004a, 2004b) also presented evidence that there are significant gender differences in prestimulus perception and processing of prestimulus information. McCraty et al.'s (2004b) findings show that, in general, males process prestimulus information in the posterior regions of the brain, while females appear to process prestimulus information in the frontal regions of the brain and are more attuned to emotion generating prestimulus information from the heart. However, it is possible that these findings may be confounded by the degree of emotion generated by both the emotional and calm pictures in the study.

McCraty et al.'s (2004a, 2004b) study was designed to test the hypothesis that an enhanced PSR is related to the maintenance of a state of physiological coherence and not intended to be generalized. A limitation of the study is that emotional and calm pictures elicit idiosyncratic responses; for example, people who have a fear of tarantulas may show a larger PSR to a photograph of a tarantula than people who enjoy tarantulas as pets. Idiosyncratic responses would also affect controls, so presumably any idiosyncratic reactions may cancel each

other. The idiosyncratic responses to photographic stimuli could be identified by measuring the real-time electrophysiological reaction after the photograph is shown. Categorizing pictures and then selecting a few pictures from each category to test for the degree of emotion generated by each participant prior to a PSR study can remedy this limitation.

The researchers at the Institute of HeartMath developed and tested a PSR experiment utilizing a roulette simulation as a remedy to idiosyncratic responses to emotional and calm pictures. McCraty et al.'s (in press) PSR study was the fourth in a series of roulette simulation pilot studies conducted by HeartMath (Gillin et al., 2007; La Pira & Gillin, 2006; La Pira et al., 2006). McCraty et al. studied PSR in 12 nonentrepreneurs from the U.S. who had been practicing specific emotion self-regulation techniques for more than 10 years and compared the results to the previously obtained usable data from 8 repeat entrepreneurs from the Cambridge Technopol (Gillin et al., 2007).

The nonentrepreneurs played a computer simulation of roulette based on choosing an investment amount (a bet) and then making a choice of red or black, followed by feedback on the result generated by a random number generator. 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. Participants had the option of choosing from four different investment amounts; namely: 25 cents, 50 cents, $1, or $2. Once the bet was placed, a 6-second period of silence followed, after which the sound of a roulette wheel was played for 6 seconds. The result of each run was tallied on the bottom left-hand side of the screen so that a participant knew whether she or he was winning or losing, and by how much. After a cooling down period a prompt appeared to repeat the betting process. Within each session, this process was replayed 26 times (trials) for each participant. The whole process was then repeated for each of the 8 identical administrations of

the experiment (a 2-month long iterative process of administering 2 back-to-back sessions (separated by at most 3 days), and followed by a 2 week interval between the subsequent set of back-to-back sessions). SCL and ECG, for HRV analysis, were continuously recorded during each session.

For the purpose of data analysis, each trial was divided into three segments: the prebet period (4 seconds), the postbet period (12 seconds), and the postresult period (6 seconds). The results across all 12 nonentrepreneurs showed significant separations between the win and loss curves for SCL (Session 1: prebet period, $p < 0.04$; postresult period, $p < 0.05$. Session 3: postresult period, $p < 0.001$. Session 7: postresult period, $p < 0.01$). There were significant findings for HRV win/loss curves, two of which were in the prestimulus period of Session 3 and Session 7 (Session 1: postresult period, $p < 0.01$. Session 3: prebet period, $p < 0.05$; postbet period, $p < 0.10$; postresult period, $p < 0.01$. Session 7: prebet period, $p < 0.05$; postresult period, $p < 0.05$). The results showed more evidence of a consistent intuitive ability over time in the HRV recordings than for SCL.

The study showed similar positive results in the heart rhythm data for the 8 entrepreneurs and the 12 nonentrepreneurs who had been practicing the specific emotion self-regulation techniques for more than 10 years. To the degree that future research can link emotional management techniques with the enhancement of nonlocal intuitive ability, it may be possible to train entrepreneurs to develop their intuitive ability even further.

The results showed that there was compelling evidence of consistent patterns both by experimental segment (prebet, postbet, and postresult) and also across the sessions indicating that a nonlocal intuitive effect appeared present throughout the eight repeated administrations of the experiment. This is an important finding because there is some evidence suggesting that repeated

administration of an experiment involving nonlocal information/interaction leads to a decline in the experimental nonlocal effect observed (Braud, 2002).

Theoretical Literature Relevant to Prestimulus Response

This section provides brief descriptions of theories that are relevant to PSR. A comprehensive overview of the myriad of theoretical frameworks applicable to PSR is outside the scope of this literature review.

Mitchell (2000) believes, "It is likely that most, if not all, subtle, ephemeral and unexplained phenomena are connected, directly or indirectly, with the phenomenon of nonlocality" (p. 229). In physics, nonlocality is a direct influence of one object on another distant object separated by space or time. For example, in this PSR study, a nonlocal source of information about the future targets (red or black) may have influenced the participants' physiology.

In order to build a theoretical explanation for time reversal cause and effect dynamics, Rauscher and Targ (2001) added 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 constructed a complementary micro scale domain which established nonlocality as a property of this 8-dimensional universe.

The capacity to receive and process information about nonlocal events appears to be a fundamental property of all physical and biological organization, and may be due to an inherent interconnectedness and inseparability of everything in the universe (Bohm & Hiley, 1993; Laszlo, 1995; Nadeau & Kafatos, 1999).

Theories of nonlocality (see review by Cramer, 1997) at the quantum level may apply to macro level nonlocal events such as PSR. From the micro scale of the quantum level to the macro scale of the four-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 with other physical objects. 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. It is possible that the interaction among these wave fields generates an interference pattern which spectrally encodes 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 may be a quantum hologram, containing quantum level information reflecting the macro scale process. It is possible that each quantum hologram also contains quantum level information about the future organization of the macro scale object with which it is associated. This provides information processing mechanisms by which intuitive knowing of future events can occur (Bradley, 1996).

Several theories have used the concept of nonlocal quantum interconnectedness as a physical means or medium to explain transmission of future information (Bohm, 1980; Gabor, 1946; Lazlo, 1995; Marcer & Mitchell, 2001; Marcer & Schempp, 1997, 1998; Mitchell, 2000; Pribram, 1991; and Tiller, 1999, 2004).

Recently, Bradley (2006) described a quantum holographic theory of entrepreneurial intuition that can be applied to PSR.

> 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. We hypothesize, therefore, that the more the entrepreneur maintains coherent attentional interest directed to the object of interest, the more his body's psychophysiological systems will access to this implicit field of quantum holographic information, and, hence, the greater the intuitive foreknowledge about the object of interest. (p. 15)

Testing theories to explain the mechanism of PSR is outside the scope of this study. The following section reviews measures of paranormal beliefs and experiences.

Overview of Measures of Paranormal Beliefs and Experiences

Goulding and Parker (2001) added new information to a review by Irwin (1993) of instruments used to measure paranormal beliefs and experiences. Goulding and Parker found that different researchers defined the term paranormal in different ways, and the definition informed their choice of psychometric instruments used to measure paranormal beliefs and experiences. The Paranormal Belief Scale (Tobacyk & Milford, 1983) was the most widely used paranormal beliefs and experiences measure. It measures seven factors of paranormal belief and includes aspects such as the belief in witchcraft and the belief in extraordinary life forms.

Paranormal belief is one of the most consistent effects in predicting performance in extrasensory perception (ESP) tasks (Lawrence, 1993). ESP is the reception of information not gained through the recognized senses (vision, hearing, taste, smell, and touch) or inferred from experience. The difference between believers in ESP and disbelievers in ESP, known as the sheep-goat effect, has been confirmed by many researchers. A meta-analysis by Lawrence (1993), covering 73 experiments by 37 different researchers, clearly confirmed that participants who believed in ESP obtained, on the average, higher results in ESP tasks than those who did not believe in ESP.

Goulding and Parker (2001) claim that the Australian Sheep-Goat Scale (Thalbourne & Haraldsson, 1980) is the most accepted measure of paranormal beliefs and experiences. Other measures of paranormal beliefs and experiences include Schmeidler's (1943) Criterion 1 Question: "Do you believe it is possible that ESP can be shown under the conditions of this experiment?"; the Incomplete Sentence's Questionnaire (Van de Castle & White, 1955); the Sheep-Goat Questionnaire (Bhadra, 1966); and the Belief in the Paranormal Scale (Jones, Russell & Nickel, 1977).

Chapter 3: Research Methods

General Design

The purpose of this study was to explore the question, "Do factors of personality correlate with electrophysiological measures of prestimulus response (PSR), and if so, which ones?" by statistical correlation of PSR electrophysiological responses with scores on personality tests.

This study used the following procedure: Over 1000 candidates who expressed interest in the study were given a screening questionnaire. Based on the answers provided for the screening questionnaire, the first 100 candidates who met the screening criteria were invited to complete the MBTI Form M. The MBTI data were hand scored using the procedure described on the Form M scoring templates to generate raw points for the eight factors (i.e., Extrovert, Introvert, Intuition, Sensation, Thinking, Feeling, Judging, and Perceiving) and to categorize each participant to four of the eight personality factors. In this study, to sample the polarities of the categories, 42 participants consisting of 21 people with the highest respective scores on the MBTI Intuition and Sensation scales were selected for inclusion in the study. The dichotomous preferences, Intuition and Sensation, were selected because PSR may be a measure of an aspect of intuition. Two candidates selected for participation in the Sensation category were unable to partake in the study due to moving out of the area.

Electrophysiological data were acquired at least 4 days after the MBTI was administered. This was done in order to reduce the risk that participants' knowledge of their MBTI scores might affect their electrophysiological data. For example, a participant who was told that his or her MBTI Intuition score was high might feel pressured in order to substantiate his or her high MBTI Intuition score. In order to reduce this bias, participants were not told their MBTI scores. Electrophysiological, ECG (for HRV), and SCL were acquired during a PSR experiment

utilizing a roulette simulation developed and tested by the Institute of Heart Math (see Procedure section). For each participant, HRV and SCL were analyzed separately for win and loss trials for three segments of each trial—prebet, postbet, and postresults. Random permutation analysis was used to generate *z*-scores to determine statistical significance of the differences in HRV and SCL respectively in win and loss trials. Stouffer *Z* scores were calculated for participants categorized to the eight personality factors of the MBTI in order to determine which personality factors, if any, correlated with electrophysiological evidence of PSR. Further analysis was conducted based on gender and age of the participants (see Chapter 4).

There were three rationales for selecting this research design. The claims of PSR research are radical, in that they appear to require fundamental revisions or extensions of current physical theory, and are therefore legitimate grounds for skepticism. It built upon previous rigorous scientific experiments conducted in PSR research. This PSR experimental design eliminated the idiosyncratic responses associated with calm and emotional photographs in previous PSR studies; used 26 trials to minimize habituation, boredom, and fatigue; and increased emotional relevance by providing feedback, paying each participant the amount she or he won, and awarding the participant who won the most in the experiment a bonus of $100.00 and a "1st Place – Best in Roulette" certificate. The experimental design provided a strict standard for acquiring PSR electrophysiological data. For example, in each trial, the target was selected by a random number generator after the electrophysiological data were acquired and recorded. The experiment protocol was easier to replicate than other research designs such as phenomenological research.

Participants

Flyers (see Appendix A) announcing the research project and calling for participants were placed at a variety of community bulletin boards throughout Northern California by a

poster distribution service. The flyer was also placed in mailboxes of students at local schools such as the Institute of Transpersonal Psychology, the Pacific Graduate School of Psychology, Foothill College, Golden Gate University, and the Psychology Department at Stanford University. The flyers included a brief description of the study and contact information. Advertisements, using the same information as the flyer, were placed online on Craigslist and in newspapers including the San Francisco Chronicle, San Jose Mercury News, Palo Alto Daily News, and Stanford Daily.

A Consent Form (see Appendix B) and a Screening Questionnaire (see Appendix C) were provided to anyone showing interest in participating in this study. The MBTI Form M was administered to 100 candidates for the study who signed the consent form, were at least 18 years of age and answered "Probably Does" or "Definitely Does" to "Do you believe that intuition/ premonition exists?" and "Probably Yes" or "Definitely Yes" to "Have you had any experiences that you believe were intuition/premonition?" on the screening questionnaire. These questions were a version of sheep-goat questions (see overview of measures of paranormal beliefs and experiences section in Chapter 2). Forty-two participants consisting of 21 people with the highest respective scores on the MBTI Intuition and Sensation scales were selected for inclusion in the study. Two candidates selected for participation in the Sensation category were unable to partake in the study due to moving out of the area. Diversity was achieved because the participants represented both genders, different ethnicities, and a variety of vocations.

Inclusion criteria included the answers "Probably Yes" or "Definitely Does" to "Do you believe that intuition/premonition exists?" and "Probably Yes" or "Definitely Yes" to "Have you had any experiences that you believe were intuition/premonition?" on the screening questionnaire. Exclusion criteria included answering "Yes" to "Do you have a gambling

addiction?"; reporting a current illness that affects HRV and SCL; reporting current use of any medication, supplements, and/or recreational drugs that affect HRV and SCL; recall of MBTI factor scores/points if MBTI was taken prior to this study, and age less than 18 years on the screening questionnaire.

Procedure

Participants completed the MBTI Form M at least 4 days prior to the PSR electrophysiological data acquisition experiment. The PSR experiment utilized a roulette simulation developed and tested by the researchers at the Institute of HeartMath (Gillin et al., 2007; La Pira & Gillin, 2006; La Pira et al., 2006; McCraty et al., in press). Participants who qualified for the experiment were notified and scheduled for individual 45-minute sessions at the researcher's office in Palo Alto, California. The participants were initially briefed on the experimental procedure. Then the experimenter invited each participant to rinse his or her hands in water (without using soap) and dry them thoroughly. When the rinsing and drying were complete, the experimenter fastened Biopac MP150® skin conductance electrodes to the index and middle fingers of the nondominant hand. The electrode cables were secured to the palm by a piece of tape to minimize any mechanical motion being transmitted to the electrodes.

Next, an approximate ¾ inch circular area of skin located 4 inches to the left and 3 inches below the base of the sternum along with an identical circular area of skin positioned 4 inches to the right and 3 inches below the base of the sternum were wiped with a preparation pad that contained alcohol and pumice. Two Biopac MP150® ECG electrodes were applied, one to each ¾ inch circular area. A ground electrode was similarly applied to the right of the base of the sternum.

After all of the electrodes were applied and connected to the Biopac MP150®, each participant sat in a comfortable chair in front of a computer monitor positioned at eye level and

approximately 1 meter distance from the participant. The experimenter checked to insure that the various signals were being sufficiently acquired and that the qualities of the signals were adequate for future analysis. The experimenter recorded the date, time, and location for potential future analysis of the influences of geomagnetic field, local sidereal time, gradient of Shannon entropy, and other factors that are outside the scope of this study.

At first, the experimenter recorded baseline data for 6 minutes. Once the baseline data were collected, the experimenter told the participant that she or he was participating in a computer simulated roulette wheel gambling experiment, and instructing them to win as much as possible over the course of 26 trials. The participant began with a $20.00 credit. The participant initiated the first trial by clicking the computer-attached mouse using his or her dominant hand. Six seconds after initiating the trial, the participant was asked to choose the simulated investment amount of 25 cents, 50 cents, $1, or $2 and to choose either red or black. Once the bet was placed, a 6-second period of silence followed, after which the sound of a roulette wheel played for 6 seconds. The target (red or black) was then determined by a random binary output using a random number generator. The result of each run was tallied on the bottom left-hand side of the screen so that the participant received feedback and knew whether she or he won or lost each trial, and a running total (win/loss) was displayed. After a cooling down period of 4 seconds, a prompt appeared to repeat the betting process, which initiated the next trial. The experimenter left the room after the first trial and the participant completed the experiment alone.

After completing the experiment, the participant called for the experimenter to return to the room. Upon returning, the experimenter removed the electrodes from the participant. The participant was paid in cash any amount that she or he has won.

At the end of the study, the participant who won the most money was notified by a phone call and received a bonus $100.00 and a "1st Place – Best in Roulette" certificate by mail.

Instruments

A Biopac MP150® (McMullen & Kremer, 2007) was used to acquire electrophysiological data. It has the ability to acquire SCL, ECG, and signals outside the scope of this study such as skin temperature, pulse, respiration, airflow, nerve conductance, continuous blood pressure, and so on.

The Myers-Briggs Type Indicator Form M was used to measure personality characteristics. The MBTI was selected because it has been used in hundreds of research studies and has amassed extensive evidence of acceptable validity and reliability (Murray, 1990).

The Myers-Briggs Type Indicator is a forced-choice, self-report inventory, self-administered without any time limits, that attempts to categorize individuals according to an adaptation of Carl Jung's theory of psychological type (Myers & McCaulley, 1985). The MBTI categorizes individuals along four theoretically independent dimensions, each of which has dichotomous preferences. The dichotomous preferences for general attitude toward the world are extraverted (E) – actively outward persona direction, and introverted (I) – internally focused energy and attention. The dichotomous preferences for ways of perceiving data from one's environment are sensation (S) – attention to actual sensory realities perceived as facts and details, and intuition (N) – focus on global insight and possibilities triggered by sensory input. The dichotomous preferences for judging function are thinking (T) – reliance on logic, sequential reasoning, and objectivity in decision making, and feeling (F) – reliance on personal values and more subjective attunement to how one personally relates to others and one's world. The final dichotomous preferences are perceiving (P) – people who dislike structure, interpret deadlines as flexible, and hold off on decision making in order to gather additional information, and judging

(J) – people who like organization and structure, show a need for closure and consequent willingness to come to conclusions with less input, and make prompt decisions that curtail continuance of receiving further input on a given issue in the service of reaching a goal. The dichotomous preferences are scales of the MBTI (i.e., E-I scale, S-N scale, T-F scale, and J-P scale).

The reliability of the MBTI has been established primarily though measures of internal consistency, specifically split-half coefficients and test-retest scores. McCaulley (1981) reported the following split-half reliability coefficients ranges for nine college student samples: "from .76 to .88 for E-I scale (median .81), from .75 to .90 for S-N scale (median .85), from .68 to .86 for T-F (median .77), and from .80 to .85 for J-P (median .82)" (p. 315).

While the reliability scores of internal consistency for individual preference scales may be important for comparing the MBTI with other personality instruments, it is the reliability of type, not of individual scales, that is most important, according to McCaulley (1981). McCaulley cited nine samples, including 1,444 individuals, who were tested and retested at intervals of 5 weeks to 6 years and noted that

> 70 to 80% of the subjects in the various samples scored three or all four preferences the same on retest. From 10 to 20% scored two preferences the same on retest, 2 to 7% scored one preference the same, and only one individual in all of the samples scored all four preferences differently. (p. 318)

Murray (1990) reviewed a large number of studies and concluded that the construct validity of the MBTI was supported in that "the four scales measure important dimensions of personality that approximate those of Jung's typology theories" (p. 1191). Myers and McCaulley (1985) addressed the question of whether the MBTI's validity is supported when its preference scores are correlated with other instruments that purport to score the same constructs. Of special significance were correlations between the MBTI and the Gray-Wheelwright Jungian Type

Survey because both instruments were constructed to identify the Jungian types. Myers and McCaulley cited a study of 98 students that produced the following correlations between the two instruments: "E .68 ($p < .01$), I .66 ($p < .01$), S .54 ($p < .01$), N .47 ($p < .01$), T .33 ($p < .01$), and F .23 ($p < .051$)" (p. 209). These correlations seem low. There is no outside standard for the qualities of the Jungian Types; therefore, the MBTI or the Gray-Wheelwright Jungian Type Survey or both instruments may not be accurate measures for Jungian Types. Myers and McCaulley also provided numerous specific correlations between the MBTI's four preferences scales and specific constructs of other personality measures such as the Adjective Check List, the California Psychological Inventory, the Eysenck Personality Questionnaire, and the Sixteen Personality Factor Questionnaire. These correlations support MBTI's construct validity.

The strengths of the MBTI include the fact that preferences being measured by the assessment are indicative of normal behaviors with minimal value connotations and also may be viewed as positive, and that specific preferences have been found to cluster within creative, scientific, business, and social occupations (Keyser & Sweetland, 1984). The MBTI has been shown to correlate with performance in computer psi games (Berger, Schechter, & Honorton, 1985) and psi ganzfeld performance (Honorton, Barker, Varvoglis, Berger, & Schechter, 1985). Weaknesses include response effect and concern that the mood of the examinee, especially in its use for screening in a high demand situation, may distort the results without any indices being built into the instrument to detect these errors (Keyser & Sweetland, 1984).

Treatment of Data

Myers-Briggs type inventory. The MBTI data were hand scored using the procedure described on the Form M scoring templates in order to generate raw points for the eight factors (i.e., Extrovert, Introvert, Intuition, Sensation, Thinking, Feeling, Judging, and Perceiving) and

to categorize each participant by four of the eight personality factors, for example, Introvert (I), Sensation (S), Feeling (F), and Judging (J).

Skin conductance levels. Each of the 26 trials was divided into three segments: the prebet period (4 seconds), the postbet period (12 seconds), and the postresult period (6 seconds). To reduce the data generated by sampling at 500 samples per second, the low frequency skin conductance channel was resampled at 10 samples per second. Because measurement focused on how the physiology changed from the moment a given segment was initiated, each sample in each segment was transformed into a percentage difference score, *D*, relative to the baseline SCL value at the moment the segment begins. Percentage difference scores were computed for win and loss trials. To compute the percentage difference score, the first data point in each trial was subtracted from each of the remaining data points in the segment (e.g., the prebet period of 4 seconds sampled at 10 samples/second yields 40 data points). Then each point in the segment was divided by the original value of the first data point of the segment to yield the percentage difference series, in which the first data point was always zero.

Heart rate variability. ECG data used for heart rate variability (HRV) analysis were all derived from normal sinus intervals and sampled at 500 samples per second. 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. The RR interval on an ECG was the interval used to calculate the heart rate (see Figure 1).

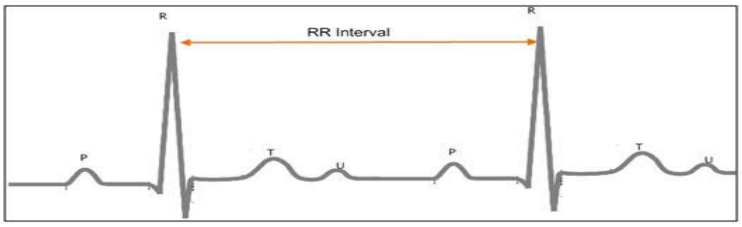

Figure 1. Schematic representation of normal ECG trace (sinus rhythm) with waves and RR interval labeled.

A regularly spaced time series was derived from the succession of normal RR intervals by linear interpolation of the irregularly spaced series and then sampled at 10 samples per second. Linear interpolation is a method of curve fitting using linear polynomials. If two known points are given by the coordinates (x_0, y_0) and (x_1, y_1), the linear interpolant is the straight line between these points. Each experimental trial was divided into three segments: the prebet period (4 seconds), the postbet period (12 seconds), and the postresult period (6 seconds).

Percentage difference scores, *D*, were computed for win and loss trials. The first HRV data point in each trial was subtracted from each of the data points in the segment (e.g., the prebet period of 4 seconds sampled at 10 samples/second yields 40 data points). Then each point in the segment was divided by the original value of the first data point of the segment to yield the percentage difference series for HRV.

Statistics for skin conductance levels and heart rate variability. To reduce the possibility of false positive findings, a decision was made to use statistically conservative procedures for data analysis, following McCraty et al. (2004a & 2004b). Randomized permutation analysis (RPA) was used to determine statistical significance of the differences between win and loss curves during the three segments because it controls for autocorrelations inherent to electrophysiological signals and their underlying nonnormal distributions (Blair & Karniski, 1993). For the RPA, a random distribution was constructed over 1,000,000 permutations.

Applied separately to each individual's SCL and HRV data, RPA generated one standard deviate, or *z*-score, per segment for each subject, which is the win/loss difference for each segment (Radin, 1997b).

The RPA method example: One participant's experimental session of 26 trials resulted in a randomly ordered presentation of 16 win and 10 losses. For each trial, win/loss percentage difference measures (*D*) were determined. For each of the samples in the data segment, the average of the *D* values across the 16 wining trials, D_W, were calculated, and then the average of the *D* values across the 10 lose trials, D_L, were calculated. Next, the difference between each of the samples D_W and D_L values were determined, $d = D_W\text{-}D_L$, during the prebet segment (postbet and postresults were analysed separately) and then these differences, *d*, were summed, $åd_o$, where the "*o*" refers to the observed summed difference.

Next, the original win vs. lose assignments were scrambled to create 16 new "pseudo-win" and 10 new "pseudo-lose" trials. That is, the original data stayed the same, but the assignments of which trials were win and which were loss were randomly scrambled, retaining the original proportion of 16 win and 10 lose. Then the data were evaluated exactly as before, creating average win and lose curves, determining the difference between the curves, and forming a summed difference value, *åd*. This process was repeated to build up a distribution of randomly permuted *åd* values.

After each new permuted value was generated, the mean (m) and the standard deviation (s) of the distribution along with a standard normal deviate measure, $z = (åd\text{-}m)/s$ was updated. The permutation process was repeated 1,000,000 times. This *z*-score, a measure of the difference between win and lose physiological responses per participant, was determined for the

prebet (z_{prebet}), postbet (z_{postbet}), and for the postresult segments ($z_{\text{postresults}}$) each in separate analysis.

Correlation of MBTI category to evidence of prestimulus response. Participants were categorized into four of eight personality categories (namely, Extrovert, Introvert, Intuition, Sensation, Thinking, Feeling, Judging, and Perceiving) using the procedure described on the MBTI Form M scoring templates. The Stouffer Z score is a standard normal deviate formed by summing *z*-scores and dividing by the square root of the number of summed scores. The method was used to combine individual win/loss *z*-scores for participants in each of the eight categories in order to determine which personality category, if any, correlated with electrophysiological evidence of PSR. For further analysis, participants were sorted by gender and age and Stouffer Z scores were recalculated for participants in each of the eight personality categories (see Chapter 4).

Internal Validity

Possibly the most obvious artifact might arise if there is sufficient information in the actual target sequence to allow a participant to infer the next target. This study eliminated this possibility by using a random number generator to determine the target for each trial. The random number generator used was an Araneus Alea 1, which provided high quality, unbiased, and uncorrelated random numbers that passed a number of stringent statistical tests, including the Diehard and NIST. Targets generated using the random number generator were inspected periodically and did not depart significantly from chance.

A common threat to validity is the response effect: the tendency of those completing questionnaires and taking personality tests to provide inaccurate information that is not a correct representation of their own experience. To reduce response effect, the experimenter used open

communication and active listening without the display of enthusiasm or disgruntlement that might have encouraged participants to distort responses.

A bias that can affect correlations between personality measures and other variables occurs when the participants' knowledge of their personality scores affects their answers on other measures. In this study, it is possible that knowledge of the scores on the personality measures might affect the participants' electrophysiological data. For example, a participant who is told that his or her Intuition score is high might have felt pressure to substantiate his score during the roulette simulation, and therefore might have indirectly altered his or her electrophysiological data. To reduce this bias, participants were not be informed of their scores on the personality measures, and the electrophysiological data were acquired at least 4 days after the participants have been administered the MBTI.

In order to minimize any tampering with the output by participants or experimenter, as soon as a session was completed, the output file was stored on the computer hard drive, a flash drive, and e-mailed to a second secure computer for analysis. A researcher blind to the sample conducted a check of the analysis of the data.

For the duration of the study, the computers used in this study were dedicated and not used for any other purpose. This reduced any interference with the program and randomness. The secure computer, used for analysis, was password protected and not accessible to anyone unauthorized to conduct the analysis.

Participant fraud based on unauthorized bodily movements during the experiment did not pose an issue because the body movements that generate false data signals are readily identifiable.

Participants were instructed to complete all 26 trials without being allowed an option to stop in the middle of data collection. No preliminary or practice runs were available for any of the participants. All acquired data were included in the analysis.

External Validity

External validity involves the extent to which the results of this study can be generalized beyond the sample and setting. The findings cannot be generalized to other people (population validity) or settings (ecological validity). However, the experiment is easy to replicate and reduces experimenter effect found in other research designs such as phenomenological research, intuitive inquiry, and organic inquiry, by minimizing experimenter involvement in the collection and analysis of the data.

Experimenter effect may occur in this study because the experimenter knew in advance the participants' scores on the MBTI factors and thus might have unconsciously treated participants categorized by certain personality factors differently from those categorized by other personality factors. However, a potential impact of this biasing factor on participants' electrophysiological data cannot be determined. To minimize this possible bias, the experimenter used a standardized script for the 45 minute session during which the electrophysiological data were collected. The experimenter was in a positive emotional state during each session and expected to find electrophysiological evidence of PSR in this study.

Chapter 4: Results

Overview

This chapter includes descriptive data of the participant demographic characteristics and presents the findings of this study.

Participant Characteristics: Demographic Data

Age. Mean age of the participants was 35.9 years with a range of 18 to 58 years.

Gender. There were 21 female and 19 male participants in this study. Table 2 shows a comparison of participants' gender by age. Female participants were relatively older as a group than the males.

Ethnicity. The ethnicity of the participants was European-American (42.5%), Asian (32.5 %), African-American (12.5%), Latino (10%), and Filipino/Pacific Islander (2.5%).

Relationships. The relationship status of the participants was single (50%), married (30%), in a committed relationship (12.5%), divorced (5%), and widowed (2.5%).

Vocation. Participants' self report of vocations included visiting scholar, research scientist, tax preparer, software engineer, paralegal, business manager, nurse-psychologist, musician, professional DJ, spiritual guide, store manager, business development manager, hypnotherapist, teaching assistant, mechanic, educator, physician assistant, accounting manager, recruiter, merchandiser, emergency medical technician, executive assistant, transportation driver, logistics manager, chauffeur, warehouse manager, and technical writer. Fifteen percent of the participants reported that they were students, and another 15 % of the participants reported being unemployed.

Table 2

Comparison of Participant Gender by Age

Age Range	*N*	Female (*n*)	(%)	Male (*n*)	(%)
18-25	9	3	(7.5%)	6	(15%)
26-30	8	4	(10%)	4	(10%)
31-40	8	3	(7.5%)	5	(12.5%)
41-50	10	6	(15%)	4	(10%)
51-58	5	5	(12.5%)	0	(0%)
Totals	40	21	(52.5%)	19	(47.5%)

Overall Findings

Overall, the average participant winnings were $1.87, and the electrophysiological results did not show statistically significant unconscious foreknowledge of the winning bets.

Correlation of MBTI Categories to Electrophysiological Evidence of PSR

Stouffer *Z* scores were calculated for participants categorized to the eight personality factors of the MBTI in order to determine which personality factors correlated with electrophysiological evidence of PSR (see Treatment of Data section of Chapter 3). Participants categorized as Sensation on the MBTI demonstrated significant HRV prestimulus responses to correct guesses about future targets in the prebet segments ($N = 19$, $Z = -1.83$, $p = .0333$). Participants categorized as Judging on the MBTI showed almost significant HRV prestimulus responses to correct guesses about future targets in the prebet segments ($N = 16$, $Z = -1.60$, $p = .0546$). Table 3 displays a prebet HRV analysis based on MBTI category. Analysis of postbet HRV (before the result was known), prebet SCL, and postbet SCL did not indicate significant prestimulus responses to correct guesses about future targets.

Table 3

Comparison of Prebet HRV Analysis by MBTI Category

MBTI Category	*N*	Mean of HRV	*SD*	Difference	Stouffer *Z* of HRV	*p* =
Sensation	19	0.0155	49.81	-19.18	-1.83	0.0333*
Intuition	21	-0.0071	50.00	-0.22	-0.01	0.4954
Extroversion	25	0.0068	56.57	-12.80	-1.13	0.1283
Introversion	15	-0.0017	38.82	-3.27	-0.61	0.2696
Thinking	14	0.0035	52.82	-6.84	-1.06	0.1445
Feeling	26	0.0037	48.35	-10.51	-0.80	0.2116
Judging	16	0.0006	46.26	-17.14	-1.60	0.0546
Perceiving	24	0.0057	52.35	-3.95	-0.34	0.3685

*$p < .05$ (two-tailed)

Further Stouffer *Z* score analysis showed that females, as a subgroup, demonstrated significant HRV prestimulus responses to correct guesses about future targets in the prebet segments ($N = 21$, $Z = -1.84$, $p < .0331$). However, males did not show significant HRV prestimulus responses to correct guesses about future targets in the prebet segments. Furthermore, in females, Sensation correlated with significant HRV prestimulus responses to correct guesses about future targets in the prebet segments regardless of age (Age < 35.9 years, $N = 6$, $Z = -2.21$, $p = .0137$; and Age > 35.9 years, $N = 6$, $Z = -1.67$, $p = .0474$).

In females, Extroversion ($N = 5$, $Z = -1.80$, $p = .0358$), Feeling ($N = 4$, $Z = -1.84$, $p = .0327$) and Perceiving ($N = 4$, $Z = -1.90$, $p = .0284$) showed HRV prestimulus responses to correct guesses about future targets. However, these findings are only suggestive due the small samples. There were no additional significant findings for gender and age for postbet HRV,

prebet SCL, and postbet SCL. Table 4 displays a comparison of prebet HRV analysis based on gender, age, and MBTI personality factor categories.

HRV and SCL showed significant deflection in postresults segments ($p < .001$), indicating an emotional response of participants to finding out whether they won or lost their bet.

Table 4

Comparison of Prebet HRV Analysis by Gender, Age, and Personality Factor

Gender, Age, and Personality Factor	*N*	Mean of HRV	*SD*	Difference	Stouffer *Z* of HRV	*p* =
Female	21	-0.0050	46.89	-21.19	-1.84	0.0331*
Age < 35.9 years	8	-0.0010	65.97	-52.08	-2.21	0.0135*
Intuition	2	-0.0405	66.07	-31.84	-0.60	0.2738
Sensation	6	-0.0024	47.86	-27.04	-2.21	0.0137*
Extroversion	5	-0.0060	74.98	-60.72	-1.80	0.0358*
Introversion	3	0.0074	50.94	-37.68	-1.29	0.0992
Thinking	4	-0.0181	62.64	-32.24	-1.29	0.0993
Feeling	4	0.0161	69.29	-71.93	-1.84	0.0327*
Judging	5	-0.0159	63.44	-39.26	-1.09	0.1369
Perceiving	4	0.0138	68.50	-64.91	-1.90	0.0284*
Age > 35.9 years	12	-0.0074	35.15	-0.18	-0.60	0.2741
Intuition	7	-0.0213	37.95	14.93	0.73	0.2331
Sensation	6	0.0104	48.90	-40.49	-1.67	0.0474*
Extroversion	5	0.0039	36.48	-25.44	-1.32	0.0932
Introversion	8	-0.0145	34.32	12.35	0.28	0.3899
Thinking	5	-0.0110	32.44	1.24	-0.87	0.1919
Feeling	8	-0.0052	36.84	-4.32	-0.08	0.4694
Judging	8	0.0020	33.57	-15.85	-1.30	0.0970
Perceiving	5	-0.0225	37.68	19.69	0.67	0.2499

Gender, Age, and Personality Factor	*N*	Mean of HRV	*SD*	Difference	Stouffer *Z* of HRV	*p* =
Male	19	0.0132	53.25	4.00	0.08	0.4663
Age < 35.9 years	11	0.0066	60.31	-6.92	-0.46	0.3212
Intuition	8	0.0019	60.18	-14.94	-0.79	0.2136
Sensation	3	0.0062	60.66	14.46	0.41	0.3418
Extroversion	11	0.0031	60.31	-6.92	-0.46	0.3212
Introversion	0					
Thinking	4	0.0293	65.46	-19.95	-0.55	0.2925
Feeling	7	-0.0119	57.37	0.53	-0.17	0.4328
Judging	2	-0.0081	57.81	-36.27	-0.90	0.1848
Perceiving	9	0.0056	60.86	-0.40	-0.09	0.4639
Age > 35.9 years	8	0.0270	43.56	19.02	0.67	0.2499
Intuition	4	0.0165	42.72	18.53	0.56	0.2885
Sensation	4	0.0375	44.39	19.51	0.40	0.3458
Extroversion	4	0.0368	48.39	46.73	1.42	0.0771
Introversion	4	0.0172	38.72	-8.68	-0.47	0.3190
Thinking	1	0.0590	64.88	106.73	1.64	0.0501
Feeling	7	0.0224	40.51	6.49	0.10	0.4601
Judging	2	0.0365	51.09	41.04	0.69	0.2436
Perceiving	6	0.0238	41.04	11.68	0.38	0.3527

*$p < .05$ (two-tailed)

Chapter 5: Discussion

This chapter discusses the results of the research findings. The purpose of this study was to explore the correlation of personality characteristics with electrophysiological evidence of prestimulus response.

The MBTI Form M was administered to a pool of 100 candidates. In order to sample the polarities of the categories, 42 participants consisting of 21 people with the highest respective raw scores on the Intuition and Sensation factors of the MBTI were selected for the study. Two candidates selected for participation in the Sensation category were unable to partake in the study due to moving out of the area. Electrophysiological data were acquired utilizing a Biopac MP150 data collection system while conducting a roulette simulation experiment developed by the researchers at HeartMath. The data were analyzed to see which personality factors on the MBTI correlated with electrophysiological evidence of PSR.

Summary and Integration of Results

Sensation. Participants categorized as Sensation showed significant HRV prestimulus responses to correct guesses about future. On the MBTI, Sensation and Intuition are dichotomous preferences for ways of perceiving data from one's environment. Sensation is the attention to actual sensory realities perceived as facts and details, and Intuition is a focus on global insight and possibilities triggered by sensory input (Myers & McCaulley, 1985). It is possible that the roulette experiment created an environment that favored participants categorized as Sensation, because this experiment primarily focused on factual information based on sensory reality such as how much money to bet and whether to chose red or black.

Judging. Participants, categorized as Judging, showed almost significant HRV prestimulus responses to correct guesses about future. People who are categorized as Judging, on

the MBTI, like organization and structure, show a need for closure and consequent willingness to come to conclusions with less input, and make prompt decisions that curtail continuance of receiving further input on a given issue in the service of reaching a goal (Myers & McCaulley, 1985). Therefore, it is possible that the roulette experiment design was more engaging for people who were willing to make prompt decisions with less input (categorized as Judging).

Females. Females, as a subgroup, showed significant HRV prestimulus responses to correct guesses about future. Females are often considered more intuitive than males, however, to date, all PSR studies have small samples and therefore gender differences cannot be generalized.

Roulette Simulation Scenario

Participants self-selected for this study and showed an interest in gambling. Participants complained that the design of the roulette simulation was too primitive and expressed a preference for a roulette simulation that would include a film clip or video of the roulette wheel spinning. Nonetheless, the significant deflections of HRV and SCL in postresult segments, indicating emotional reaction of participants to finding out whether they won or lost their bet, point to the evidence of participants' emotional engagement. Based on the positive results of this study, the roulette wheel simulation provided a good gambling scenario for recording electrophysiological evidence of PSR.

Comparison of Findings to Past Literature

Convergent findings with past literature. The results of this study showed significant HRV prestimulus responses to future targets as found in previous PSR studies (see Chapter 2, Gillin et al., 2007; La Pira & Gillin, 2006; La Pira et al., 2006; McCraty et al., 2004a, 2004b, in press).

Divergent findings with past literature. The findings in this study did not show significant SCL prestimulus responses to future targets as found in PSR studies by other investigators (see Chapter 2, Bierman 2000; Bierman & Radin, 1997; May et al., 2005; McCraty et al., in press; Parkhomtchouk et al., 2002; Radin, 1997b, 2004; Spottiswoode & May, 2003).

Contribution to prestimulus response research. This study contributed to the large body of PSR research by demonstrating HRV prestimulus responses to correct guesses about future targets in a broader sample than previous PSR studies by other investigators (i.e., Gillin et al., 2007; La Pira & Gillin, 2006; La Pira et al., 2006; McCraty et al., 2004a, 2004b, in press). In this study, the participants were not screened for meditation and self-regulation practices as in studies by Radin (1997a, 1997b) and McCraty et al. (2004a, 2004b). In addition, Sensation, on the MBTI, was found to correlate to significant HRV prestimulus responses to correct guesses about future targets. Furthermore, this study contributed to PSR research by showing females, as a subgroup, showed significant HRV prestimulus responses to correct guesses about future targets. Males watered down the overall results. Therefore, in future research it seems advisable to report results separately by gender as well as a total.

The findings of this study are preliminary and correlation of personality factors with electrophysiological evidence of PSR warrants further research. Studying the correlation of personality characteristics to electrophysiological measures of PSR applies to all areas of our lives, and may inform the selection of people for roles that may benefit from having information about future events before these events actually take place.

Limitations

There are inherent limitations to any experiment. The first one is attributable to the limitation of the MBTI which includes response effect and concern that the mood of the examinee may distort the results without any indices being built into the instrument to detect

these errors (Keyser & Sweetland, 1984). The second limitation relates to the setting in which the psychological and electrophysiological data were acquired; therefore, the findings of this study may not be generalized to other settings. The third limitation is sample related. Because the sample used in the study was limited to residents of Northern California, the findings of this study may not be generalized to other geographical samples.

Delimitations

This study has two major delimitations. The first major delimitation of this study is the size of the sample. Ideally, this experiment would involve a much larger sample that could fully represent all possible scores on the MBTI. The MBTI Form M was administered to a pool of 100 candidates. In order to sample the polarities of the categories, 42 participants consisting of 21 people with highest respective raw scores on the Intuition and Sensation factors of the MBTI were selected for the study. The dichotomous preferences, Intuition and Sensation, were selected because PSR may be a measure of an aspect of intuition.

The second major delimitation of this study was not measuring all of the possible physical, physiologic, and psychological factors reported in the literature that may influence the conscious registration of intuition. Physical factors that may possibly influence the conscious registration of intuition include the momentary geomagnetic field (the earth's electromagnetic atmosphere), local sidereal time (the time at which a particular part of the sky is directly overhead), the gradient of Shannon entropy (changes in level of information content) inherent in a target, and other possible physical influences of entropy (see Braud, 2002; May, Spottiswoode, & James, 1994; Persinger, 1985; Spottiswoode, 1997a, 1997b). The measurement of momentary geomagnetic field, local sidereal time, gradient of Shannon entropy, and other possible physical influences of entropy are outside the scope of this study; however, the location, date, and time of the experiment were recorded for potential future analysis.

There are a myriad of physiologic factors that may influence the conscious registration of intuition (e.g. hormonal fluctuations). Ideally, all possible physiologic measures would have been included in this experiment. However, the electrophysiological data were limited to HRV and SCL for comparison with current research studies.

Favorable psychological factors that may influence the conscious registration of psi include feedback, level of motivation, relaxation or arousal, hypnosis, dreams, some drug-induced states, structures of consciousness beyond those conventionally recognized (i.e., pre- and perinatal stages of development, stages of advanced psychospiritual development, and stages near death or antistructures of consciousness [Braud, 2002]). These were outside the scope of this research. Scores on one personality measure, the MBTI, were included in this study. The MBTI was selected because it has been found to correlate with intuitive processes (Honorton et al., 1985).

Suggestions for Future Research

Suggestions for future research include using other measures of personality, in addition to the MBTI, to correlate personality characteristics with electrophysiological evidence of PSR. Revising the roulette simulation experiment with a video of the roulette wheel spinning might increase participants' engagement and produce a larger PSR effect. Some of the significant results in this study were suggestive due to small sample size. Replication of this study with a larger sample might support these preliminary suggestive findings. Future PSR studies might also show that it is possible to train people to improve their intuitive ability and to use their body's electrophysiological responses to inform choices and decisions in business, learning, overall well-being, creativity, medical diagnosis, healing, and spiritual growth.

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Appendix A: Recruitment Flyer

You are invited to participate in a gambling study - a computer roulette simulation where the target, red or black, is randomly determined using a random number generator. You get to keep your winnings - possibly over $150!

In this study, while you play roulette, we will monitor the properties of your skin at your fingertips and your heart rate using noninvasive electrodes attached adhesively to your skin.

If you are interested in this study, please contact me at the e-mail address below and I will send to you by e-mail a consent form and screening questionnaire, which will take approximately 10 minutes. Based on your responses to the questionnaire, you will receive a call or an e-mail to let you know if you have been selected to complete a paper-and-pencil personality measure, which will take approximately 25 minutes. Based on your answers to the personality measure, you will receive a call or an e-mail to let you know if you have been selected for the gambling study. The gambling study will take place at an office in Palo Alto, California and will take approximately 45 minutes.

Based upon previous research and experience, the potential benefits of participating are making money and a sense of contribution to the advancement of science.

Contact Paula at
gamblingresearch@123mail.org
if you are interested or if you would like more information.

Appendix B: Consent Form

CONSENT FORM
(GAMBLING STUDY) CONFIDENTIAL INFORMATION

Dear Participant:

You are invited to participate in a gambling study where you get to keep your winnings. This study explores two electrophysiological measures: skin conductance levels (SCL) and heart rate variability (HRV) using noninvasive electrodes that will be adhesively attached to your skin during a gambling simulation experiment.

Survey Questionnaire
You will receive via email this consent form and a questionnaire, which will take you approximately 10 minutes to complete. Based on your responses to the questionnaire, you will receive an e-mail or call to inform you if you have been selected to complete a paper-and-pencil personality measure for this study which will take approximately 25 minutes. You will be asked to complete this consent form before taking the paper-and-pencil personality measure. Based on your answers to the personality measure, you will receive an e-mail or a call to inform you if you have been selected for the gambling study.

Roulette Gambling Experiment
If you are selected for the gambling study, you will be scheduled for a 45 minute session at an office in Palo Alto in order to record Skin Conductance Levels (SCL) and Electrocardiogram (ECG) for Heart Rate Variability (HRV) using noninvasive electrodes that will be adhesively attached to your skin, during a gambling simulation experiment. During this session you will be asked to wash your hands (no soap). Noninvasive SCL electrodes will be adhesively attached to the first two fingers of your nondominant hand. An approximate ¾ inch circular area of skin 1 inch to the left of the approximate base of the sternum, another ¾ inch circular area of skin 4 inches to the left of first will be prepped with a pad containing alcohol and pumice. Noninvasive ECG electrodes will be adhesively attached to these areas. A noninvasive ground electrode will also be adhesively attached to your skin. You will then be instructed to play a roulette simulation on a computer. You will be given a $20 credit. For each of 26 trials you will be asked to place a bet of 25 cents, 50 cents, $1, or $2 and to choose a target color of either red or black After you choose either red or black, a random number generator will determine the target color. Following 26 experimental trials you will be paid any amount you win over the $20 credit. It is expected that the total time for the session will not exceed 45-minutes.

At the end of the study, if you have the won the most money compared to all of the other participants in the study, you will be notified by an e-mail or a call and you will be mailed a "1st Place – Best in Roulette" certificate and a bonus of $100.00.

Based upon previous research and experience, the potential benefits of participating are increased self-understanding, a sense of contribution to the advancement of science, and an opportunity to win money.

CONSENT FORM CONTINUED
(GAMBLING STUDY) CONFIDENTIAL INFORMATION

For the protection of your privacy, all information received from you will be kept confidential, and your identity will be protected. All written material pertaining to this part of the study will be kept in locked file cabinets and will be accessed only by the researcher. Code numbers will be used to identify you during the analysis of the data. In reporting of information in published material, any information that might identify you will be altered to ensure your anonymity.

This study is designed to minimize potential risks to you. Having noninvasive SCL and ECG electrodes adhesively attached to your skin has minimal risk; you may experience some abrasion and/or coolness may be felt, and you may notice some redness in the areas prepped for application of the electrodes.

You may experience some feelings arising that may include discomfort or excitation. If at any time you have any concerns or questions, I will make every effort to discuss them with you and inform you of options to resolve them.

Participating in this study with a known gambling addiction could be detrimental to you. Do not participate in this study if you have a known gambling addiction.

If you have any questions or concerns you may call me at 503-946-3902 or e-mail me at gamblingresearch@123mail.org, or call my chairperson, Arthur Hastings, Ph.D., or Frederic Luskin, Ph.D., Chairperson of the Ethics Committee for Research at the Institute of Transpersonal Psychology, at 650-493-4430. The Institute of Transpersonal Psychology assumes no responsibility for psychological or physical injury resulting from this research.

If you decide to participate in this research, you may withdraw your consent and discontinue your participation at any time during the conduct of the study and for any reason without penalty or prejudice. You may request a summary of the research findings by proving your mailing address with your signature.

I attest that I have read and understood this form and had any questions about this research answered to my satisfaction. My participation in this research is entirely voluntary and no pressure has been applied to encourage my participation. My signature indicates my willingness to be a participant in this research.

_____ _____
Participant's Signature Date

_____ _____
Researcher's Signature Date

CONSENT FORM CONTINUED
(GAMBLING STUDY) CONFIDENTIAL INFORMATION

NAME (please print): _____

Address_____

City, State, Zip_____

Phone Numbers Home_____ Work_____ Cell_____

e-mail Address_____

Circle YES or NO to indicate your preference regarding a written copy of a summary of the project results upon completion of the study. YES NO

Appendix C: Screening Questionnaire

GAMBLING STUDY QUESTIONNAIRE

CONFIDENTIAL INFORMATION

Name (please print): _____

For the protection of your privacy, all information received from you will be kept confidential, and your identity will be protected. All written material pertaining to this questionnaire will be kept in locked file cabinets and will be accessed only by the researcher. Code numbers will be used to identify you during the analysis of the data and in any reports of the results. Please complete ALL of the following questions:

Gender:_____ Date of Birth:_____

Vocation:_____

Ethnicity:_____(Please write in your ethnicity or circle the best answer): Asian European-American African-American Filipino/Pacific Islander Latino

Please circle the best answer: Single Married Divorced Widowed Committed Relationship

1. Have you taken the Myers-Briggs Type Indicator (a personality test)? Please circle Yes or No
If yes, do you recall your scores/points? Please circle Yes or No

2. Do you have any chronic illness(es)? Please circle Yes or No
If Yes, please provide a brief description.

_____
_____
_____
_____
_____
_____

3. Do you have any current serious illness(es)? Please circle Yes or No
If Yes, please provide a brief description.

_____
_____
_____
_____

GAMBLING STUDY QUESTIONNAIRE CONTINUED
(GAMBLING STUDY) CONFIDENTIAL INFORMATION

4. Are you currently taking any prescription, over-the-counter, or recreational drugs? Please circle Yes or No
If Yes, please explain.

_____
_____
_____
_____
_____
_____

5. Are you currently taking any dietary supplements? Please circle Yes or No
If Yes, please explain.

_____
_____
_____
_____
_____
_____

6. Please circle the best answer: Left-handed Right-handed

For the purpose of this study, intuition is defined as the reception of information without the use of the known senses. Intuition includes the scientific term "premonition." Premonition is the reception of information about a future event without the use of the known senses, for example, knowing what card will be played next in a game of Blackjack.

7. Do you believe that intuition/premonition exists? (Please circle the appropriate response.)

Definitely Does Not	Probably Does Not	Don't Know	Probably Does	Definitely Does

8. Have you had any experiences that you believe were intuition/premonition? (Please circle the appropriate response.)

Definitely No	Probably No	Don't Know	Probably Yes	Definitely Yes

GAMBLING STUDY QUESTIONNAIRE CONTINUED
(GAMBLING STUDY) CONFIDENTIAL INFORMATION

9. Are you a (please circle the best response) Non Gambler or Novice Gambler or Experienced Gambler?

10. If you circled Novice Gambler or Experienced Gambler, please briefly describe your gambling experience:

_____
_____
_____
_____
_____

11. Do you have a gambling addiction? Please circle Yes or No