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## Anticipatory reactions to erotic stimuli: An exploration into "psychic" ability

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ANTICIPATORY REACTIONS TO EROTIC STIMULI: AN EXPLORATION INTO  
“PSYCHIC” ABILITY

A Thesis Submitted  
in Partial Fulfillment  
of the Requirements for the Designation  
University Honors

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## Abstract

The current study investigated psi ability (precognition) based on Bem's (2011) experiments. The study used a computer-based program that tested for the prediction of erotic stimuli via erotic and non-erotic images. Sensation seeking and cortisol were explored as moderators of psi ability. Participants provided saliva samples at the beginning and end of the study for a measure of cortisol. It was predicted that participants would detect the future position of erotic images significantly more than they would by chance and more than non-erotic images. Additionally, it was predicted that those who scored high in sensation seeking would have greater psi ability than those with lower sensation seeking scores. Further, it was predicted that there would be an inverse relationship with baseline salivary cortisol levels, such that the higher the sensation seeking score, the lower the baseline cortisol level. Results indicated that participants did not predict the future position of erotic images significantly more than chance levels. Further, there was no relationship found between sensation seeking and psi ability and baseline cortisol levels.

*Keywords:* psi, precognition, sensation seeking, cortisol

### **Anticipatory Reactions to Erotic Stimuli: An Exploration into “Psychic” Ability**

Many people have had a “déjà vu” moment, a pit-of-the-stomach “knowing,” or a “crazy premonition.” Most purveyors of popular culture would attest to the notion that Extra Sensory Perception (or ESP, i.e., psychic ability or psi for short) is of great interest to many. For simplicity, the general term *psi* is used to connote the general category of such abilities throughout this paper. Interest in this topic has led to popular movies, such as *The Gift*, which features a psychic woman striving to find the missing links to a murder case through the use of her psychic visions, or the movie *Twilight* where vampires have the use of telepathy and precognition. A stroll through any public library will reveal book shelves that include many examples of fiction and nonfiction alike dealing with powers of communication outside of the five senses (e.g., *The Shining* by Stephen King).

Interest in psi ability has been longstanding in psychology, as far back as the late 1800’s, but many scientists lost interest as other fields in psychology became established and parapsychological experiments failed to be replicated (Lilienfeld, Lynn, Ruscio, & Beyerstein, 2010). This topic is now being revisited and made popular again. Removing psi-ability from the anecdotal realm and examining it empirically and systematically provides an avenue through which researchers can disentangle the real from the imagined.

The question as to the very existence of psi abilities has made for heated debate for many years. Generally speaking, among college professors in the United States, psychologists are among the most skeptical of the existence of psi ability—more so than professors in other natural sciences, social sciences, or humanities (Wagner & Monnet,

1979). Belief in the paranormal is oftentimes inflated by life experiences that seem to be much more exceptional than coincidences. For example, if a person is thinking of their mother and seconds later find a call from Mom on their cellphone screen, in the moment, that phone call may seem to have been some form of telepathy where the son/daughter was sending messages to their mother which translated into her phone call. But, in all actuality, it really is not all that improbable that mom would call at any given second (Lilienfeld, et al., & Beyerstein, 2010). People tend to underestimate how often events happen as pure chance.

Apart from general questions about the existence of psi are questions like, why is psi an important area of investigation? Theoretically speaking, psi may have been advantageous throughout human evolution. According to Bem (2011), psi is an ability acquired through evolution that worked in favor of survival and reproductive advantage. For example, if an individual had the ability to anticipate a negative stimuli, like an animal attack, he/she could thereby avoid it, and contrarily, if an individual can anticipate sexual stimuli, such as a mate, he/she could then approach it. The ability to precognitively detect such stimuli could prompt the individual to act in favor of its survival.

Critical of the evolutionary advantage of psi, Kennedy (2004), failed to see psi's applicability, and proposed that the purpose of psi is simply for the purpose of transcendence because psi seems to be more closely related to spirituality, a sense of connectedness, and meaning of life. He argued that humans evolved from motivations for self-interest, which, to him, meant that psi ability would only be advantageous for the purpose of transcendence, and that self-interest is one of the reasons underlying human

existence because people are focused on their independent need to survive. A counter argument would be that if the sole purpose is to transcend, there may still be evolutionary advantage to transcend because part of what may be self-interest involves the larger collective. For example, from an evolutionary perspective, survival would be much more likely if people worked together and understood (and possibly could feel) how each other would behave in certain situations. Such a collective effort would increase one's chances for survival and help ensure the survival of one's genes. In such situations, transcendence would be of benefit for the sake of spirituality, a sense of connectedness, and meaning of life.

Such a perspective is also consistent with previous researchers who argued that anticipating danger and thus avoiding it seems an obvious advantage for survival (Bem, 2011). Yet, the current body of literature in this area remains scant, and the understanding of psi needs additional research to better understand a) its existence, b) whether it is related to any evolutionary advantage, and c) if there are other explanations for the existence of psi. The current research focuses on the former: the existence of psi. More specifically, the current research examines a specific form of psi ability, precognition or "the acquisition of information about a future event that could not be anticipated through any known inferential process" (Bem, 1994, p. 125).

This paper begins by providing a brief overview of how psi has been conceptualized and defined by previous researchers. Second, is a brief description of arguments for and against psi ability and strengths and weaknesses of empirical research in this area. Next, is a review of Bem's work, on which the current study is based, with explanations of potential correlates of individual differences such as sensation seeking

and cortisol as a measure of stress. Finally, the current research on precognition is outlined.

### **Psi: Understanding the Basics**

The empirical push to answer questions about psi anomalies (i.e., interactions between the environment and living organisms that seem to be outside of the realm of sensory and motor systems) can be complicated by semantics, such that the basic meaning of terms themselves can be confusing (Rao & Palmer, 1987). Early research in this area was referred to as *psychical research*. More recently, however, scientists are more apt to use the term *parapsychology* (Rao & Palmer, 1987). Generally speaking, *psi* refers to “anomalous processes of information or energy transfer that are currently unexplained in terms of known physical or biological mechanisms” (Bem, 2011, p. 407). Researchers have distinguished different forms of psi ability. For example, extra sensory perception (ESP) is information shielded from the senses that includes telepathy (transfer of thoughts from one to another), clairvoyance (acquired knowledge about objects and events), retro-cognition (information about a past event), and precognition (information about a future event; Rao & Palmer, 1987).

Like the label *parapsychology*, the term *paranormal* is also unclear in its connotation, which leads scientists to deem topics under the “para” subject category unexplainable. The terms *parapsychology* and *paranormal* fall under similar connotations in that according to Webster’s Dictionary, the prefix *para* means *beyond or outside of*, so when affixed to the word *normal*, it implies that a given unexplainable occurrence exists beyond what science is capable of understanding. Given such understanding of the terms, it is no question as to why there is a preconceived idea that



topics in parapsychology are not able to be explained by science (Rao & Palmer, 1987). For this reason, researchers have also distinguished between *genuinely* paranormal and *ostensibly* paranormal. The first denotes the notion that the anomaly truly conflicts with the basic limiting principles of nature— like the impossibility of perceiving physical events outside of the five known senses. In contrast, an occurrence being labeled as *ostensibly* paranormal allows for the investigation of discovering and deciphering what is genuinely paranormal and scientifically sound. In thinking of the way the public views psi, using the term *ostensibly* paranormal allows for more room for the field in investigation to grow, whereas *genuinely* paranormal implies that it is outside the realms of science, and it stops there. If something were to genuinely fit under the category of paranormal, there would be no purpose in investigating the variable because it is fixed as unexplainable, inexplicable. The term *paranormal* also fails to consider that *normalcy* for science is relative to history because science evolves over time. If an explanation is found for paranormal phenomena, then the definition of *normal* science needs reconsideration. Because individuals hold tightly to their preconceived beliefs (Rao & Palmer, 1987), shifting from *paranormal* to *normal* is arduous and causes cognitive dissonance and ultimately, denial. It is hard to shift one's attention away from a previous misconception. Hence, as parapsychologists investigate paranormal anomalies, they use empiricism to formulate plausible explanations behind such occurrences (Rao & Palmer, 1987).

### **Psi Debate: Issues of Conclusiveness and Replicability**

Semantics is not the only issue complicating psi research. Some call into question the conclusiveness of psi experiments (Rao & Palmer, 1987). Skeptics perceive paranormal phenomena as radical because it is not something that is commonly accepted

or understood, thus demanding that proof of such phenomena be as extraordinary as the concept of psi itself (Bem, 2011). There is a lot of skepticism in the conclusiveness of psi experiments because it is unknown what type of factors can impede upon psychic research, and it is hard to control for such measures until they are discovered. Because of such uncertainty, researchers would like to see a “foolproof” experiment that addresses all confounds and limits experimenter bias (Rao & Palmer, 1987). A lot of skepticism also comes from independent psi researchers’ claims of conclusiveness when assessing their data because some scientists have argued for the existence of paranormal phenomenon in terms that conflict with the laws of nature. This leads other researchers to assume that their claims are fraudulent (Rao & Palmer, 1987). Skeptics cite precarious experimental conditions that they perceive as not being conclusive. Researchers in the psi field feel as though there is a push for perfect controls in all of their measures. In reality, however, scientific evidence is relative, with gray areas being much more prevalent than black and white. Focusing on the latter requires unequivocal results and leaves no room for further investigation outside of the original hypothesis that could be meaningful (Rao & Palmer, 1987). Thus, a stronger push is needed for a balance between having strong measures and controls, while still allowing for exploration in other findings within the study. Still, replication is important to demonstrate statistical conclusiveness among many researchers to support psi findings.

Even small effects may have important implications. For example, the effects of aspirin on heart attacks had a very small effect size, but it was discovered that aspirin could be used as a secondary preventative measure, rather than a primary prevention (Dai & Ge, 2012). Impartiality is an important precursor to questioning established opinions

and is necessary to open up skeptics' minds to the notion that small effect sizes may have meaning. Effect size refers to the magnitude, or size, of a treatment effect. This is not the same as statistical significance, which provides evidence as to whether the differences among two or more treatments are greater than would be expected by chance alone.

Effect sizes allow for emphasis on the magnitude of the difference. So, even if there is a small effect, when thinking about research areas outside of the norm, Honorton (1976) argues for open-mindedness within the scientific community:

The scientific community has an obligation to assess, without prejudice, the serious research in this area. The only way in which this can be done is through dissemination of research reports to a wide scientific audience... this would have the effect, not of providing an endorsement of any claims, but rather of stimulating critical discussion and future replication. (p. 215)

Fighting against skeptics' preconception that science must have all the answers to fundamental psi questions, Honorton (1976), expressed his frustration that because all of the questions cannot be answered, doubters feel this entitles them to reject parapsychological data that goes against their beliefs. Such lingering questions include the physical and the mental transfer of time, the "reading" of someone's thoughts, or intuitions outside of the five senses. These questions involve ideas that many are uncomfortable with because they appear to be outside the "laws of science" (Palmer, 1993).

Traditional scientific research generally includes variables closely linked to the five senses: vision, touch, taste, smell, and hearing. Because psi research is thought by many to be less objective, it is more easily (and often more harshly) critiqued and/or

suffers outright rejection by more hard line empiricists. The argument that psi is improbable because it conflicts with commonly known laws of science is an easy position to argue because, as yet, there are no fully acceptable explanations behind whether psi might exist. Without understanding the applications of psi, it becomes difficult to pose a hypothesis or research question about psi ability because there is an unrealistically high standard being set. Nevertheless, the presumption that just because an occurrence is unexplained means it conflicts with the laws of science seems short-sighted. The ever-changing nature of science often leads to new ways of thinking that can also lead to radical shifts in how people think and leads some psi researchers to attempt to normalize that which is considered “paranormal” (Palmer, 1993).

The replicability of psi research is another area of concern for critics as they struggle to replicate early claims of psi ability (Lilienfeld, et al., 2010). The degree to which a study can be replicated speaks to the reliability of results. Replicability does not mean that research findings need to be identical across empirical research studies, but that statistical evidence is consistent with respect to the original finding. Namely, identical results are usually not possible due to intervening variables, but that is not to say that replicability cannot be improved (Rao & Palmer, 1987). Yet, maybe more than any other more traditional fields in psychology, there is an unrealistically higher bar for replication in psi research (Kennedy, 2004; Rao & Palmer, 1987; Skinner, 1937; Wolfe, 1938). A push for more or higher replicability results does serve as a good argument as it pushes researchers to aim for more rigorous experimental design and data analysis.

### **Empirical Research into Psi Ability**

The history of empirical psi research has been turbulent. The pioneering London group, the Society of Psychical Research, tried but failed at establishing psi research as a legitimate science (Bem, 1994; Rhine, 1968). This group of scholars was established in 1892 to investigate claims pertaining to mesmeric, psychical, and spiritualistic occurrences without bias (Bem, 1994). Unfortunately, after the founders passed away, interest declined, limiting any theoretical and empirical advances in the area. It was not until nearly 25 years later that renewed efforts in the area began with a focus on clairvoyance and telepathy (Rhine, 1968).

In 1927, J.B. Rhine with his wife and collaborator at Duke University were some of the first researchers to develop clairvoyance experiments with cards, coined Zener cards, containing geometric symbols (Bem, 1994; Rao, 1987). These tests involved the conscious selection of a target from a restricted set of four or five targets. One of those targets would be randomly selected later. The participant's task was to predict which target would be randomly chosen later (Radin, 2011). Although this methodology represented an advancement over earlier research into psi, it was still criticized as having "less-than-rigorous" experimental conditions. For example, his procedures were criticized on the premise that the Zener cards could be see-through under certain light conditions which is a form of sensory leakage, or in other words—the participants were being given the answer, whether or not they realized it. To address such critiques, Rhine used screens and distance to prevent the participant from seeing through the cards. Additionally, he was one of the first to implement double-blind testing procedures in which neither the participant nor experimenter knew what symbolled card would be chosen (Rao & Palmer,

1987). Even though Rhine improved his measures, his studies were not successfully replicated by independent researchers (Lilienfeld, et al., 2010). Sensory leakage was still of concern as other researchers attempted to replicate his studies using his Zener cards.

The initial criticisms of Rhine's methodology led to the development of the *ganzfeld procedure* (Bem, 1994). The ganzfeld procedure aimed to test telepathy through carefully controlled measures. The experiment was replicated 42 times with an above chance hit rate (35%; Bem, 1994). It focused on eliminating sensory noise (anything interfering with the five sense). Researchers believed that routine sensory stimuli could obstruct the ability to detect psi information, so to isolate interference, the receiver was led through relaxation exercises while sitting in a reclining chair in a soundproof room with translucent ping pong ball halves placed over the eyes and listening to white noise played through headphones. The "sender," in a separate soundproof room, concentrated on a "target," which would be a randomly selected picture or videotaped sequence. At the end of the experiment, if the target with the highest rating by the sender was the target the receiver was experiencing, it was scored as a hit. With the presence of four potential targets, chance dictates a probable hit rate of 25%. Being that the experimenter played a significant role in conducting the experiment, it was hard to control for experimenter bias. Another issue would be that of sensory leakage, where the receiver would somehow be able to obtain the target information through cheating or normal sensory fashion if the safeguards put in place to avoid sensory leakage failed. For example, Rhine put a screen up between the cards and the participants. If those screens failed to cover the symbols on the cards, or if participants could pick up clues from the researcher, then sensory cues

would give away their target. For such reasons, it was frequently criticized for a lack of repeatable psi effect and inadequate controls and safeguards.

In an attempt to address these continuing critiques, Hyman and Honorton (1986) collaborated to outline more stringent methodology and statistical standards. As a result, a new methodology was developed referred to as the *autoganzfeld* procedure that was conducted via a computer in order to eliminate the potential for researcher bias. The computer system controlled the random selection of targets and presentation of the targets, and the reporting of the participants' ratings. They made specific instructions for more rigorous methodology and for other researchers to replicate. The autoganzfeld experiments showed the same hit rates as the ganzfeld procedures, and replicated and extended results obtained via the earlier ganzfeld studies by finding support for individual differences in psi ability, such that creative or artistically talented people showed higher psi ability.

Milton and Wiseman (1999) assessed 30 studies not included in Bem's meta-analysis of the ganzfeld experiments and found that the size of the psi effects corresponded to chance performance, going against Bem's findings. These results are curious in that Bem and Honorton failed to add 30 studies that contradict their findings. Other researchers believe that the statistical analysis of the meta-analysis had serious shortcomings. This back and forth argument about the ganzfeld experiments being replicable and conclusive remains unanswered (Milton & Wiseman, 2001). For this reason, it is important to keep replicating and publishing results, even those with null findings.

More recently, psi research methodology has shifted toward using subliminal stimuli and implicit responses such as physiological indices of emotional arousal (Bem, 2011). For example, research in this area focused on monitoring unconscious responses prior to the random selection of future events. These studies were referred to as *presentiment studies*, distinguishing them from precognition in that they were based on physiological feeling rather than cognitive knowing. Unconscious responses were tested by measuring the psychophysiological fluctuations prior to an unpredictable stimuli.

According to Radin (2011), this means that “a future emotional response is predicted to cause greater nervous system activity in the present than would a future calm response” (p. 206). In his research, Radin measured skin conductance, heart rate, pupil dilation, brain electrical activity, and blood oxygenation while research participants viewed a series of randomly selected targets. Participants would view a series of pictures on a computer screen as their emotional response was monitored physiologically. Most pictures were emotionally neutral, but on random trials a negative or erotic picture was displayed. When the images appeared on the screen, strong emotional arousal was observed to happen a few seconds prior to the image being displayed (Bem, 2011; Radin, 2011). In one study, targets included pictures that were happy versus sad faces, silence versus audio tones, light flashes versus no flashes, and audio tones versus light flashes. A few seconds before the target was presented to the participants, their physiological states were measured to test whether they unconsciously anticipated the upcoming stimuli. These studies found that an emotional arousal response occurred a few seconds before the target was displayed; in other words, participants unconsciously reacted to the stimuli before having cognitive awareness of what the stimulus was (Bem, Tressoldi, Rabeyron,



& Duggan, 2015). As a whole, the presentiment studies represented an advancement in the area of psi research because they helped elucidate psychophysiological markers related to psi ability. Such findings provide more incentive to investigate precognitive ability in a systematic way.

### **Bem's Study**

The presentiment findings were important for psi research because increased arousal was observed before the stimuli (negative or erotic image) was presented to the research participant. They helped establish more sound and solid scientific evidence behind the existence of psi because now there exists support for physiological responses happening before conscious awareness. Building on these findings, Bem (2011) created a series of experiments using subliminal stimulus presentations such as negative or erotic images, and indirect or implicit response measures as used in the presentiment studies like guessing the future position of an image on a computer. The goal of Bem's research was to test for evidence of psi using highly controlled procedures that could be reliably replicated by independent researchers and to use statistical analyses that were simple, transparent, and familiar. An additional goal was to address previous criticisms of psi research by minimizing the experimenter role through the use of computer controlled stimuli presentation (Bem, 2011). The participants' responses were measured before rather than after the stimulus event in an attempt to reverse the usual series of events (described in detail below). He divided the nine experiments by the type of psychological effect matching with each type of time-reversed experiments.

Bem's studies focused primarily on precognition and retro-cognition. He tested precognition by having participants guess the future position of images and retro-

cognition by retroactive priming, retroactive habituation, retroactive habituation of boredom, and retroactive facilitation of recall, all described below.

Bem examined the psychological effect (participant's emotional response) of affective priming in two separate studies. Typically, an affective priming experiment involves participants judging a picture as pleasant or unpleasant as quickly as possible as preceded by a priming word such as "beautiful" or "ugly." Individuals are expected to answer more quickly to the picture if the word matches the attitude of the picture, such as a negative picture matching a negative prime. Bem's retroactive version of the method displayed the prime after, rather than before, the picture. The first retroactive experiment yielded significance in participants' ability to judge the attitude matching the picture more quickly on congruent trials rather than incongruent trials, being that when a picture matched the valence of the word, participants were able to judge more quickly, which shows evidence for affective priming. The next experiment replicated the previously mentioned retroactive affective priming and produced the same effects (Bem, 2011).

Three additional experiments examined habituation, which is the effect of diminished arousal after repeated exposure. Normally, the experiment is conducted by repeatedly exposing a subliminal picture (habituation target) to the participant. Then, the participant is asked to choose which picture they like better out of two pictures displayed side by side—the target picture and a closely matched picture the participant has not seen. The trial is scored as a hit when the participant chooses the target picture. In the retroactive version of this experiment, the steps are switched so the participant is first asked which picture he/she likes better and then the computer system randomly selects one of the two pictures as the habituation target to subliminally display. The results of the

first experiment showed that participants preferred the target significantly more frequently than the non-target on trials with the negative picture pair. The second experiment replicated the first, but also added erotic picture pairs. Results showed the same effect as the first experiment on negative picture pairs, and also reported that participants preferred the target significantly less on the erotic picture pair trials. These findings supported Bem's hypothesis that participants would prefer the target picture less often on the erotic trials (Bem, 2011). The third experiment of habituation was the retroactive induction of boredom. Bornstein, Kale, and Cornell (1990) suggested that boredom competes with habituation as the number of exposures go up, which causes the stimulus to be less liked as boredom overtakes habituation. The shorter the exposure, the stronger the mere exposure effect is, with the most effective being the subliminal exposures. Because of the difficulty in defining the optimal number of exposures for the effect, Bem varied the number of exposures for this experiment. The hit rates did not show significance, but they did fall in the predicted direction (Bem, 2011).

For the facilitation of recall, Bem conducted two experiments testing memory as working retroactively by seeing if the rehearsal of a certain set of words makes them easier to recall, even if the recall test is before the rehearsal. First, participants were given a set of words and then asked to freely recall them. Then, they were given a set of practice exercises on a subset randomly selected from the first set of words. After the first experiment, results supported that the recall test reaches back in time to facilitate the recall of those words because participants had to think back to the list of words in order to recall them later. The second experiment was a replication of the first with a component of a new practice exercise introduced directly after the recall test to further

aid in the recall of the practice words. This version of the experiment showed a stronger psi effect for retroactively recalling a list of words (Bem, 2011).

Of particular importance to the current research, Bem conducted two experiments examining precognitive approach and avoidance through detection of erotic stimuli and avoidance of negative stimuli. The presentiment research described earlier provided initial support for the idea that humans can anticipate (via physiological responses) unpredictable erotic or negative stimuli before they actually occur. These experiments tested whether individuals can precognitively detect and approach erotic stimuli and detect and avoid negative stimuli. This was accomplished by having participants try to detect the future position of erotic or negative images compared to neutral images. In the first study testing approach of erotic stimuli, it was hypothesized that if participants detect the position of erotic stimuli significantly more often than neutral images, then there is evidence for precognitive approach toward erotic stimuli. In the second study testing avoidance of negative stimuli, it was hypothesized that if participants could detect the target-to-be, then it was scored a hit for avoidance of negative stimuli. These experiments will be further explained below.

The precognitive detection of erotic stimuli experiment, which is what the current research is replicating, is done by computer. The computer system displays two curtains side-by-side. One of the curtains will have an image behind it—the participant is asked to click on the curtain he/she feels has the picture behind it. Then, the computer flips a virtual coin to decide which curtain will display the picture. If the participant chooses the correct curtain, an image would be displayed and it would be scored a hit. The hit rate of erotic trials can be compared to that of non-erotic trials to discover if anything unique

exists behind erotic images outside of their positive valence and high arousal value. Bem's results indicated that participants were able to precognitively detect the erotic images significantly better than chance. The hit rate for erotic images was also significantly higher compared to neutral images.

The precognitive avoidance study examined participants' ability to avoid negatively arousing stimuli, which would be evolutionarily advantageous. The participant was shown a low-arousal neutral picture and its mirror image side by side. They were then asked to indicate which picture they preferred. After the participant expressed their preference, the computer would randomly choose one of the two images to be the target image. A positively valence picture was subliminally displayed three times if the participant preferred the target-to-be. When the participant preferred the non-target, the computer subliminally flashed a highly-arousing negatively valence picture. Participants portrayed avoidance of negative stimuli if they indicated preference for the target-to-be. Significance was found in the precognitive avoidance of negative stimuli, providing support for psi performance to avoid negative stimuli before it actually appears, such that participants were able to detect the target-to-be before it was subliminally flashed on the screen because it showed that by choosing the target-to-be, participants avoided the negatively valence image (Bem, 2011).

Other researchers conducted Bem's studies in hopes to replicate and find significance. In a meta-analysis of independent researchers replicating Bem's experiment in 90 experiments, from 33 different laboratories, and 14 different countries, that there is indeed evidence for the existence of anomalous anticipation of random events, and that the replicability of the original experiment can be done successfully (Bem, et al., 2015).

The meta-analysis aimed to address whether the database of studies found overall evidence for the anomalous anticipation of random events, and whether independent investigators can successfully replicate Bem's original experiment. Both research questions were provided with supported evidence for the anomalous anticipation of random events and the replication of Bem's study. This is consistent with the rationale previously outlined by Bem that the ability to anticipate sexual opportunities acts as part of reproductive advantage which leads to approach oriented thoughts and action tendencies (Bem, 2011). Again, this research design used erotic and non-erotic images to test the presentiment finding that one's physiology can anticipate unpredictable erotic stimuli before they occur. Bem claims that such anticipation is advantageous for reproduction in that organisms that act instrumentally to approach erotic stimuli should also be able to avoid an anticipated negative stimuli. Theoretically, such erotic pictures will act as reinforcement for correct precognitive guesses.

In addition to testing for approach and avoidance precognitive effects, Bem also examined whether individual differences in sensation seeking impact one's ability to precognitively detect stimuli. Results indicated a significant correlation between sensation seeking and psi ability such that participants who scored high in sensation seeking had better performance in psi ability. Participants reporting higher levels of sensation seeking correctly identified the position of erotic images significantly more frequently than would be expected by chance (Bem, 2011). Those who scored low in sensation seeking did not differ significantly from chance. The current research was designed to test the replicability of Bem's earlier work on precognitive detection of erotic

images and extend it to include sensation seeking and salivary cortisol as a measure of stress.

Because there are a lot of questions and skepticism about psi ability and the publishing of only successful experiments, the current study aims to explore the replicability of Bem's experiments along with his claim that sensation seeking is related to psi ability (Bem, 2011; Rao & Palmer, 1987).

### **Sensation Seeking**

According to Zuckerman, Bone, Neary, Mangelsdorff, and Brustman (1972), sensation seekers are those "who need varied, novel, and complex sensations and experiences to maintain an optimal level of arousal" (p. 308). Sensation seeking is a facet of extraversion. Extroverts (compared to introverts) are more prone to seek out novel sensory experiences because they have a tendency to become bored easily. It is argued that such tendencies relate to higher cortical arousal thresholds, or in other words, that extroverts require higher level stimulus for arousal (Eysenk, 1967). Psi ability may be heightened in persons reporting higher levels of sensation seeking due to the fact that normal sensory thresholds are intensified while an individual is relaxed (Eysenk, 1967). Additionally, given that higher thresholds for cortical arousal are found in extroverts, they can deal with the arousal and still perform effectively (Ball & Zuckerman, 1992; Eysenk, 1967; Sargent, 1981). That is to say, novel activities stimulate high sensation seekers, thus improving their ability to focus while experiencing lower levels of cortical arousal, than would a non-sensation seeker. Such ability to focus potentially has evolutionary implications in that high sensation seekers can simultaneously concentrate on what is most pertinent or gratifying while also checking their surroundings for possible threats

(Martin, 1986; Zuckerman, 1990). In short, high sensation seekers demonstrate a better ability to focus their attention during a high-stimulus event.

Research suggests that sensation seeking itself is multifaceted. For instance, a person may be high in one facet (e.g., boredom susceptibility) but not others (e.g., disinhibition, experience seeking, thrill and adventure seeking). According to Zuckerman (2007), people who score high sensation seeking search for novel stimuli to compensate for the shortage of optimal arousal by the Catecholamine system activity (CSA). Catecholamines include dopamine and norepinephrine which are part of the brain's reward system, also part of the noradrenergic system. For this reason, it may be that sensation seekers are susceptible to boredom, compelling the high sensation seeker to seek out novel stimuli.

### **Cortisol**

Salivary cortisol is a reliable measure of the hypothalamic-pituitary-adrenocortical axis' (HPA) activation (Dickerson & Kemeny, 2004). Cortisol is a principal glucocorticoid hormone that plays a primary role in allostatic stress responses (Kirschbaum & Hellhammer, 2000), regulating blood pressure, glucose metabolism, and immune responses (Gold, Goodwin, & Chrousos, 1988). Heightened HPA axis activity can be detrimental to cognitive and affective processes, which can have health and disease implications (Tyrka, Mello, Gagne, Grover, Anderson, Price, & Carpenter, 2006). Prolonged cortisol exposure leads to the suppression of immune responses as well as other systems in the body that help it run efficiently (Gold, et al., 1988). Newer theories of cortisol suggest that heightened stress reactivity may reflect an increased biological sensitivity to the environment, with risk for negative health effects under adverse



conditions, and positive effects under supportive and protective conditions. From an evolutionary stand-point, the developmental plasticity of the stress response systems may have developed in part for conditional adaptation such that psychobiological mechanisms monitor specific features of childhood environments as a catalyst to the development of the stress response systems' ability to adapt to those environments. The stress response system is structure and context dependent, meaning that psychophysiological responses depend on the perceived environment (Boyce & Ellis, 2005).

Assaying cortisol via a saliva sample is a non-invasive, yet reliable, measure of stress. Other estrogens and other medical conditions can affect cortisol levels within a person, so having additional measures, such as a questionnaire, provide more information about individual saliva samples (Hellhammer, Wust, & Kudielka, 2008). Through a demographic questionnaire, individual saliva samples are better understood in terms of confounding variables that may not be relevant to stress itself.

### **Current Study**

Given previous research suggesting that individual differences, such as sensation seeking, may impact psi ability, the current research had two primary goals. First was to test the replicability of Bem's earlier research finding support for precognitive detection of erotic images. A second goal was to examine the relation between psi ability and theoretically related individual difference measures, namely, sensation seeking and stress level. As noted by Bem, sensation seeking represents one facet of extraversion. Thus, the current research sought to extend Bem's initial findings by examining the link between different facets of sensation seeking and psi ability using a previously validated sensation

seeking scale to better determine if one or more facets of sensation seeking might be driving any obtained effects.

In addition, the current research also investigated the relation between psi ability and baseline stress levels. The current research also examined if individual differences in baseline levels of stress levels could help account for a high sensation seeker's superior ability at psi performance. Shabani, Deghani, Hedayati, and Rezaei (2011) investigated the relationship between cortisol and sensation seeking and found a significant negative relationship between cortisol and sensation seeking such that the higher the score on the sensation seeking scale, the lower the concentration of baseline salivary cortisol. These findings were consistent with earlier research by Rosenblitt, Soler, Johnson, and Quadagno (2001) who found an inverse relation between cortisol and sensation seeking among men (but not women).

### **Research Questions**

From the sensation seeking evidence, it is expected that participants who score high in sensation seeking will also demonstrate greater psi ability. Whereas Bem provided support for an initial link between psi ability and sensation seeking, his two-item measure of sensation seeking was not previously validated. Given this relationship, one might expect the emergence of a negative relation between cortisol and psi ability that is moderated by sensation seeking such that psi ability should be most pronounced among high sensation seekers with lower baseline cortisol levels.

## Methods

### Participants

There were 106 participants including 51 males and 54 females (one participant chose not to indicate their gender), from a mid-sized Midwestern university. Participants received partial course credit for their participation. Participant ages ranged from 18-33 ( $M = 19.3$ , Median = 19, Mode = 19,  $SD = 2.05$ ). The majority reported being Caucasian (non-Hispanic, 84%), followed by Hispanic or Latino(a) (5.7%), African American (3.8%), and Asian or Pacific Islander (5.6%). The vast majority of participants indicated being single (97.2%). Two participants failed to complete the experiment due to personal preferences.

### Procedure

Upon arrival, participants were informed that they would be participating in an experiment that tested for ESP and would be asked to give saliva samples at different points throughout the course of the experiment. Participants were asked to sign an informed consent sheet to finalize their participation. Prior to administering the experimental manipulation, participants were asked to complete a computer-based demographics questionnaire. After the demographic questionnaire, participants assessed the “Reading the Mind in the Eyes” Test. In addition, saliva samples were collected twice during the experiment: before and after the experimental task. Only one participant was run at a time per session. The experimental task utilized a software program used in previous psi research (Bem, 2011). Immediately prior to the experimental task participants were instructed as follows:

This is an experiment that tests for ESP. It takes about 25 minutes and is run completely by computer. First you will answer a few brief questions. Next, the program provides a 3-minute period of relaxation during which the program plays a soundtrack of “New Age” music while displaying moving images of the starry night sky. Next, on each trial of the experiment, pictures of two curtains will appear on the screen side by side. One of them has a picture behind it; the other has a blank wall behind it. Your task is to click on the curtain that you feel has the picture behind it. The curtain will then open, permitting you to see if you selected the correct curtain. There will be 36 trials in all.

Some of the pictures in this experiment contain explicit erotic images (e.g., couples engaged in nonviolent but explicit consensual sexual acts). If you object to seeing such images, you should not participate in this experiment.

Immediately after completing the experimental task, the experimenter provided participants with additional details on their task performance. Consistent with previous research on precognition (Bem, 2011), participants were instructed as follows:

As you can tell from the procedure itself, we are interested in whether people can use ESP to detect whether the picture will be on the left or on the right. What is not obvious from the procedure, however, is that this experiment is specifically designed to test for precognition, a form of ESP in which a person can anticipate the future.

To do this, the computer doesn’t actually decide the placement of the picture until *after* you have already made your choice. Before you make your choice, the computer **itself** doesn’t yet know where the picture will be. Instead, it waits until

you have already made your choice and then it flips a virtual coin to decide whether to put it on the left or the right.

If there is no ESP, then we would expect people to see the picture on approximately 50% of the trials by pure chance. So, if people are successful at seeing the picture on significantly more than 50% of the trials, we will have evidence for precognition.

We were really testing the procedure more than the participants' own ESP ability, such that some people might have ESP ability even though it does not show up using this procedure.

After completing the experimental task, participants were asked to complete a series of scales designed to assess various individual differences including: NEO Five Factor Inventory, Types of Intuition Scale, Sensation Seeking Scale, Empathy Quotient, Paranormal Beliefs Scale, and Daily Spiritual Experiences Scale. After completing the questionnaires, a second saliva sample was collected modeling the first. After collecting the second saliva sample, participants were debriefed about the nature of the experiment testing for precognitive ability and also were provided with a description of how the computer system worked and what erotic and non-erotic scores meant. Finally, participants asked any remaining questions they had about the research, which were subsequently answered by the experimenter, and then participants were dismissed.

### **Stimuli**

Bem (2011) collected the erotic and non-erotic images from the International Affective Picture System (IAPS; Lang & Greenwald, 1993). They come from a set of 820 digitized photographs that have been rated on a 9-point scale for valence and arousal by

males and females. Erotic images consisted of partners engaging in explicit, consensual sexual activities, similar to that of some styles of pornography. Participants had the option to choose their preference of erotic partnership engagement consisting of male with male, female with female, and male with female action. Non-erotic images consisted of neutral pictures such as scenery or an image of someone holding a cup of coffee with minimal affect shown.

### **Computer Apparatus**

Each participant viewed erotic and non-erotic images randomly intermixed whose sequence was determined by the program's internal random function. Participants were asked to guess which curtain had the image behind it, but in all actuality, the computer did not yet know the position of the image until after the participant clicked the curtain. After the participant clicked on the preferred curtain, the program would flip a virtual coin to decide the placement of the image, making for a real precognitive task, as opposed to clairvoyance— in which the image would have already been placed behind a curtain, before the participant clicked the curtain of choice.

### **Measures**

*Sensation Seeking.* Sensation seeking was measured using Zuckerman's (2007) Sensation Seeking Scale, which contains 40-items tapping into four dimensions of sensation seeking including ten boredom susceptibility a dislike of tedious repetitive tasks and people (e.g. "I can't stand watching a movie that I've seen before"), disinhibition, participating in deviant social activities like drinking and sex (e.g. "I like 'wild' uninhibited parties"), experience seeking, the quest for an unconventional existence through impulsive behavior (e.g. "I have tried marijuana or would like to"), and

thrill and adventure seeking, taking part in exhilarating risky activities and/or sports (e.g. “I would like to take up the sport of water skiing”). The response scale for the sensation seeking scale required participants to decide between two actions that best describe themselves. For example, one item required participants to select between “I like wild uninhibited parties” (A) and “I prefer quiet parties with good conversation” (B). (Zuckerman, 2007). Composite scores were created by first recoding items such that higher levels of sensation seeking were coded as “1” and lower levels of sensation seeking were coded as “0” and then summing across items. Higher values on the composite scale were indicative of higher levels of sensation seeking. This study yielded and reliability estimate (Cronbach’s alpha) for the full 40 item scale was .77.

*Eyes Test.* The “Reading the Eyes in the Mind” Test (Baron-Cohen, et al., 2015) measures a person’s ability to understand others’ emotional states based on what they see in pictures of eyes. It is a 36-item scale in which participants assessed the correct target word corresponding with the picture posed of a set of eyes. A composite score was created by adding the amount of correct target words across all 36 items. Higher scores indicated higher success. The reliability estimate (Chronbach’s Alpha) was .61.

*The Intuition Scale.* The Intuition Scale (Pretz, et al., 2014) is a 29-item scale asking participants about three types of intuition: holistic, inferential, and affective. Participants were asked to rate on a scale of one (*definitely false*) to five (*definitely true*) how true each statement is according to their decision-making in real life. Composite scores were created by first recoding items such that 1=5, 2=4, 3=3, 4=2, and 5=1, and then averaging all response items. This study’s reliability estimate (Chronbach’s Alpha) for the full-item scale yielded .63.

*Empathy.* The Empathy Quotient (Baron-Cohen & Wheelwright, 2004) measures empathy through a 40-item scale in which participants indicate the level to which they agree on the statements ranging from one (*strongly agree*) to four (*strongly disagree*). A composite score was created by adding the sum of all answers. The higher the sum, the more empathy one felt. The reliability estimate (Chronbach's Alpha) for this study for the full-scale item was .84.

*Paranormal Beliefs.* The Paranormal Beliefs Scale (Tobacyk, 2004) is a 26-item scale, which measures the degree of belief in each of seven dimensions: traditional religious belief, psi, witchcraft, superstition, spiritualism, extraordinary life forms, and precognition. Participants rated on a scale of one (*strongly disagree*) to seven (*strongly agree*) how much they agreed with the statements based on the belief of each previously noted subcategory. Composite scores were created by first recoding and then averaging scores across the scale. This study's reliability estimate (Chronbach's Alpha) yielded .80.

*Spiritual Experiences.* The Daily Spiritual Experiences Scale (Underwood & Teresi, 2002) is a 16-item scale that tests for ordinary or daily spiritual experiences. Participants rated how often they experienced particular events in the day on a scale of one (*many times a day*) to six (*never or almost never*). Composite scores were created by averaging all of the scores on each item. The reliability estimate for this study (Chronbach's Alpha) was .98.

### **Biological Data**

*Salivary Assays (Cortisol).* All samples were assayed in duplicate for both cortisol and CRP within the Psychoneuroendocrinology Lab (PNEL) at the University of Northern Iowa using highly-sensitive enzyme immunoassays (Salimetrics LLC, State



College, PA). For cortisol, unbound salivary cortisol levels are highly correlated with serum levels,  $r(47) = .91, p < .0001$  (Salimetrics LLC, State College, PA) and represent a reliable way to estimate serum cortisol levels (Francis, et al., 1987; Hiramatsu, 1981; Shirtcliff & Granger, 2002; Vining, McGinley, Maksvytis, & Ho, 1983), and salivary assay represents a minimally-invasive way to measure non-bound cortisol levels.

Participants in the current research were instructed to salivate by passive drool into a straw connected to a 2 ml cryovial. The sample was unstimulated and the participants allowed all saliva to be collected without interruption until a sufficient sample was collected. During the saliva collection, and in order to facilitate salivation, participants were invited to imagine the smell of something good to eat or to simulate chewing something good to eat.

Samples were frozen within 20 minutes of collection at -80 degrees Fahrenheit until analysis. The assay for cortisol uses 25  $\mu$ l of saliva per determination and has a lower limit of sensitivity of  $<.007$  ug/dL, standard curve range from 3 ug/dL to .012 ug/dL.

## Results

### Precognitive Ability (Hit Rates)

It was predicted that participants would correctly guess the future position of erotic images significantly more often than chance (50%). Contrary to prediction, participants did not correctly identify the future position of the erotic pictures significantly more frequently ( $M = 8.89, SD = 2.08$ ) than the 50% hit rate expected by chance ( $n = 9$ ),  $t(103) = -.52, p = .61, d = .11$ . Similarly, the hit rate on non-erotic pictures

( $M = 9.09$ ,  $SD = 1.87$ ) also did not differ significantly from chance ( $n = 9$ )  $t(103) = .47$ ,  $p = .64$ ,  $d = .09$ . Moreover, a repeated measures  $t$ -test was used to determine if there was a significant difference between the hit rates for erotic and non-erotic images. Results failed to indicate a significant difference in hit rates across erotic and non-erotic images,  $t(103) = -.71$ ,  $p = .42$ .

### Relations among Psi Ability, Cortisol, and Sensation Seeking

It was predicted that psi ability (precognitive ability) would be positively correlated with sensation seeking. As shown in Table 1, results failed to support this prediction,  $r(103) = -.12$ ,  $p = .22$ . Psi ability was also predicted to be related to averaged baseline and later measures of cortisol. Results did not indicate any relation,  $r(103) = -.14$ ,  $p = .19$ . It was further predicted that cortisol would be inversely related to sensation seeking. Results did not provided support for this prediction,  $r(103) = .04$ ,  $p = .72$ .

TABLE 1

*Means, SDs, & Pearson Correlations across all measures*

	M	SD	1	2	3	4
1. Cortisol	-.37	.27	___			
2. Erotic Hits	8.89	2.08	-.14	___		
3. Non-erotic Hits	9.09	1.87	.04	.02	___	
4. Sensation Seeking	17.74	6.27	.04	-.12	-.02	___

n= 104

**Exploratory Analyses**

Intuition had a strong relationship with paranormal beliefs such that a higher intuition score was positively correlated with a high paranormal belief score,  $r(103) = .41, p = .01$ . Intuition was also positively correlated with daily spiritual experiences such that high intuition scores also related to daily spiritual experiences scores,  $r(103) = .35, p = .01$ . The daily spiritual experiences scale also showed a positive relationship with paranormal beliefs,  $r(103) = .22, p = .04$ . Participants who had more daily spiritual experiences also associated with a higher score in the paranormal beliefs scale. Additionally, erotic hits had a positive relationship with a facet of the paranormal beliefs scale, paranormal belief in the supernatural, such that those who had better precognitive ability in detecting the future position of erotic images also had higher belief in the supernatural,  $r(103) = .20, p = .05$  (Table 2).

TABLE 2

*Supplementary Data Means, SDs, & Pearson Correlations across all measures*

	M	SD	1	2	3	4	5
1. Intuition	3.43	.32	—				
2. Paranormal Beliefs	3.41	1.13	.41**	—			
3. Daily Spiritual Experiences	52.38	21.13	.35**	.22*	—		
4. Erotic Hits	8.89	2.08	.01	-.07	-.03	—	
5. Paranormal Beliefs in the Supernatural	2.55	1.64	.16	.69**	.04	.20*	—

Note: <sup>a</sup>  $p < .09$ , \*  $p < .05$ , \*\*  $p < .01$ .  $n = 104$

Additionally, an independent-samples  $t$ -test was conducted to compare males and females for empathy quotient conditions. There was a significant difference in the scores for males ( $M = 38.02$ ,  $SD = 10.16$ ) and females ( $M = 42.94$ ,  $SD = 8.08$ ) in empathy;  $t(101) = -2.73$ ,  $p = 0.01$ . Females scored significantly higher on empathy than males. Additionally, another independent samples  $t$ -test was conducted to compare those who score high versus low in psi ability (above or below 50% chance) and intuition. Results indicate that a significant difference exists between those who score high in psi ability ( $M = 3.34$ ,  $SD = .32$ ) compared to those who score low on psi ability ( $M = 3.50$ ,  $SD = .30$ ) on intuition, such that those with low scores on intuition performed better in psi ability ( $t(97) = 2.46$ ,  $p = .02$ ).

### Discussion

The current research study aimed to test and replicate Bem's (2011) precognitive ability study and extend it by adding measures of individual differences. It was expected that the participant would anticipate the erotic image's position significantly more often than by chance (50%). Further investigated was the estimated relationship between sensation seeking and psi ability, which was that high sensation seekers would perform better in the psi task. Lastly, we had anticipated to establish more rigid evidence behind an explanation for high sensation seekers' ability to perform better in psi tasks by investigating salivary cortisol levels of concentration. We expected there to be an inverse relationship between sensation seekers and salivary cortisol.

Erotic and non-erotic pictures were not identified significantly more often than by chance, and there was no significant difference in hit rates between erotic and non-erotic images. Additionally, there was no relationship between sensation seeking and psi ability. No relationship was found between cortisol levels and psi ability.

Intuition had a positive relationship with both paranormal beliefs and daily spiritual experiences. Additionally, daily spiritual experiences showed another positive relationship with paranormal beliefs. And lastly, the future detection of erotic images showed a positive relationship with a facet of paranormal beliefs, paranormal beliefs in the supernatural.

Although the hypothesis were not supported by the evidence of the data, it still answers different questions about psi ability and its relationship to salivary cortisol and sensation seeking. There is importance in null findings because it answers questions pertaining to the previously stated hypothesis, such that results did not support the

replication of Bem's (2011) precognitive detection of erotic stimuli, and results also failed to show that there is any relationship between precognitive ability and sensation seeking, as well as with precognitive ability and salivary cortisol. Other studies have yielded significant findings in these areas, but it is important for researchers to keep attempting to replicate and find meaningful relationships should they exist.

The findings related to the exploratory analyses show areas that could be worth investigating further. For example, it is interesting that intuition is positively related to paranormal beliefs and daily spiritual experiences because there is also a positive relationship between paranormal beliefs and daily spiritual experiences. This could mean that there are aspects of intuition that may lead a person to have more spiritual experiences in their daily lives, which could then lead to paranormal beliefs. Another interesting finding is that Erotic hits positively correlated with the paranormal beliefs in the supernatural, a facet of paranormal beliefs. It could be that having more paranormal belief in the supernatural could have some mediating effect on precognitive detection of erotic stimuli. The gender differences between males and females on empathy also show findings supporting that perhaps women are better empathizers compared to men. Such differences may play a role on psi ability. Another interesting difference is that of high psi ability and low intuition scores because it is counter-intuitive to pair those good in psi ability with low scores in intuition because high scores in intuition could be thought to have a positive relationship with high psi ability because of the notion that intuition refers to a gut feeling.

### **Limitations and Future Research**

Several limitations exist that may have had an effect on the data. First, are factors concerning participant fatigue. The recruitment system provided a brief description of the study which also noted that it would take no longer than 30 minutes. Each participant actually ended up taking about an hour, if not, longer. There were additional measures which added time to the study, making for tired and perhaps frustrated participants. Another possible concern is the order scales and measures were administered. Because the study had a primary focus on replicability of precognition, sensation seeking, and salivary cortisol, the additional measures should have come after the primary measures. While no issues were noted, I did have five different researchers conducting the experiment; two male, and three female. Given the sexual nature of the stimuli, it is possible some participants were uncomfortable depending on who their researcher was, which may have impacted their responses. Lastly, this experiment included measures, such as erotic images and paranormal phenomenon, that could make participants feel uncomfortable. Skeptics of the field may not have taken the study seriously, thus leading to bias in their data sets. The erotic images may also have played a role in participants' responses because of cultural influences. Culturally, erotic images and pornography are generally viewed as negative stimuli, which goes against the evolutionary theory posed to explain why humans have an evolutionary urge toward approaching such stimuli. There no longer exists threat and erotic stimuli the way there would have been millions of years back through the evolutionary process. Today, erotic images may not be indicative of the way in which people naturally gravitate toward finding partners. This cultural push against erotic images and pornography may have led the participant to have negative reactions toward the images, which would then cause participants to stray away from

wanting to approach the erotic stimulus, thus it having an effect on the way in which participants chose the curtain that the erotic image would be to appear behind.

Additionally, limitations concerning power should also be addressed. There was little power in this study because of the small sample size. Because psi effects are likely small, a larger sample size would have increased the likelihood of finding a difference if one actually exists. Power was also lacking due to the fact that some statistical tests are inherently more powerful compared to others. T-tests have the tendency to cause inflation among results (Radin, 2011). Other analyses, such as Bayesian t-tests, are used to compensate for inflation. Another factor pertaining to power is that of error such that measurement error acts like distractions which can occur that do not allow for the isolation of the variable under investigation. There may have been an effect on error due to confounding variables coming from added measures.

For those interested in the area of psi, there are possibilities for rigorous, empirical research. There are many important questions pertaining to psi ability, such as the ones explored concerning the existence of psi and its correlates with individual differences. A lot of questions are posed for other effects that are mistaken for psi such as whether a phenomena is psi ability or intuition. Do believers in psi have higher psi ability as opposed to those who do not believe in psi? Could there be any other effects at play such as priming effects? These are essential questions to answer because these areas are not clear within psi research. To establish better findings within individual differences, biological markers, like cortisol, serve as effective measures because most previous research has been based on self-report measures, which are often accompanied with bias from the participant. Biological measures serve a more solid ground to establish



significant findings. For these reasons, it is important to have other measures, aside from self-report, to triangulate the data and establish more solid findings.

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