FINAL REPORT

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Seeking the Intuition Response
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INTUITION LABORATORIES, INC.
Exploration • Understanding • Application

Summary

This project was built upon observations first reported by Radin indicating that some individuals display the physiological signs of the "orienting response" several seconds before being exposed to an emotionally disturbing picture. Called "presentiment" or, more recently, the pre-stimulus response (PSR), these observations suggest the emotional system of these individuals is somehow responding to *future* information. These experimental observations have been independently confirmed in several laboratories.

It is my contention that these studies may be providing important clues to how humans process anomalous information, as in extrasensory perception or in the more common notion of intuition. In the context of an evolved human ability, the PSR, may represent tangible evidence of an information-processing system that is based on minimal information transfer and that relies on the human limbic system to trigger suitable memory patterns or bias decision-making processes to an evolutionarily advantageous end.

There were two principal goals of this research project. The first was to investigate whether the PSR will display test-retest reliability, as would be expected if we are dealing with a human ability or capability. The second is to determine if there are individual differences in the PSR. This, too, is something that would be expected if PSR were a result of a human ability. Unfortunately, the results of the project did not provide the evidence of test-retest reliability that we were seeking. In fact, the project failed to yield the overall significant evidence of PSR that we were expecting. Nonetheless, there was promising evidence of individual differences that is encouraging for future research and, perhaps, eventual application of this technique.

The full report of the scientific aspects of the project is the accompanying draft paper, "Seeking the Intuition Response" which forms part of this final report.

Activities Report

The project began with the acquisition of the needed equipment. The "PSYlab" skin conductance-measuring device was purchased from its manufacturer in London. A suitable laptop computer was also purchased and the two systems were integrated and thoroughly tested. A hardware random number generator was also purchased as a component in the test system. This proved to be somewhat problematic and extensive testing was needed. Eventually a suitable solution was found.

Since this project employs the same testing methodology as a Bial-supported project at the Laboratories for Fundamental

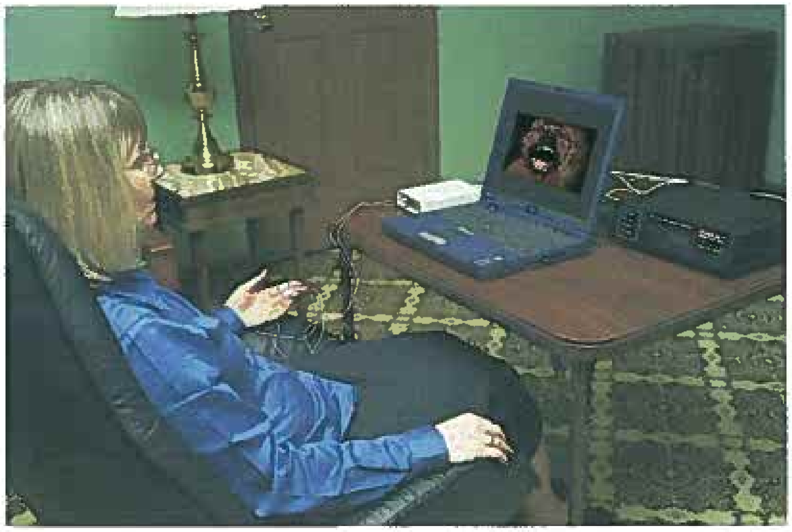
Research, we have jointly developed the software that is being used. Dr. May at LFR wrote the programs for the presentation of the stimulus pictures and the simultaneous collection of physiological data. The development, testing and debugging consumed several months. I prepared a program to analyze the data collected by Dr. May's program, display it, and store it in a master database; however, as the project developed and we realized that the analysis would be more complex than initially envisioned, this was abandoned in favor of a suite of analysis programs developed mostly by Dr May in the IDL language. For this project, I wrote a program for scoring the Myers-Briggs Type Indicator (MBTI) tests that saves the data in a database that is compatible with the analysis programs. The MBTI scoring program is more reliable than hand scoring and considerably less expensive than using the scoring service offered by the test publisher. A copy is included with this report and may be used by other Bial bursary recipients.

The MBTI test was part of the original plan to examine individual differences. After the project started, a newly published study indicated that I should include an additional test. This study revealed that in fMRI scans of the brain using the same IAPS picture set that we are employing there were significant differences in which parts of the brain were activated for extraverts and neurotics. This study used the NEO-FFI personality inventory, so I decided to include that test as well, replacing the personal interview component.

In the early stages of the project it became clear that there were potential artifacts that could seriously compromise the data and which had not been adequately dealt with in previous research. This caused a period of intense discussion, modeling and simulations. As the scientific report notes, we were able to develop a methodology that is not susceptible to these problems.

Considerable time was spent creating an experiment that would not only provide the needed data under the proper conditions, but would also be both convenient and a reasonably enjoyable experience for our participants. Special information packets conforming to National Institutes of Health standards for the protection of human subjects have been prepared. As a way of compensating participants for their time and trouble I provided each participant with a full report of their MBTI and NEO-FFI results.

Testing began in June 2001 and continued through April of 2002, as subjects were available. Testing was done at the facilities of Intuition Laboratories or at the homes or offices of the participants. While many people were willing to participate, it often was a chal-


Participant in experiment.

lenge to schedule the two one-hour visits that the experiment required.

As noted in the scientific report, 83 participants were tested. Early in the testing I discovered that one of the components of the Skin Conductance monitor was malfunctioning. The device was replaced by the manufacturer, but the data from three participants had to be discarded. The remaining 80 comprised the planned data set for the project (slightly less than my original estimate). In the first phase of data analysis, I observed that 16 of the participants did not produce useable skin conductance responses. It is not unusual to have some subjects who do not produce usable SCRs, but this number was somewhat higher than expected.

The data analysis phase proved to be more complicated and time-consuming than anticipated. As indicated in the scientific report, my collaborators at LFR and I determined that there was a serious potential for artifacts causing misleading results. In devising methods to cope with these problems, the precise method of analyzing the SC data went through many revisions as various options were tried and discarded. The general process was that Ed May and his colleagues would test analysis methods on their similar pilot data, and then I would apply it to the accumulated IAPS data. Ultimately this lead to more than one "false start" where I thought my results would be different than they ultimately proved to be, but in the end we were satisfied that the method of analysis reported in the accompanying paper is the best and most scientifically defensible currently available.

Summary of Findings

The findings of the project are reported in detail in the scientific report. To summarize them here, the project did not demonstrate overall evidence of a PSR effect, but we have learned something more about the nature of the PSR than we knew before. It appears that the PSR effect may not be a simple rise in skin conductance levels in anticipation of an emotionally arousing stimulus. Instead, the PSR effect may be one or more non-specific SCRs (NS-SCR) that the participant produces. PSR, then seems to be manifest in a greater frequency of NS-SCRs prior to the arousing stimuli than prior to the calm stimuli. The project also failed to demonstrate test-retest reliability but that may have been a result of the lack of an overall difference between the PSRs for the arousing and calm images.

Examples of IAPS images. Image on the left is arousing; image on the right is calm.

The reason this project failed to replicate the previous work is because there was no difference between the PSRs of the arousing and the calm stimuli. However, one way of looking at the data suggests this is because the calm stimuli appear to be showing a PSR as well. While this interpretation is not much more than an impression, it may suggest that there was insufficient contrast between the types of images.

One encouraging finding was that, of the three personality factors that prior research has shown to be related to ESP performance, MBTI Extraversion, MBTI Intuition, and NEO Openness, the last two were positively and significantly correlated with individual's PSR. No other factors were correlated. This is a very good indicator that we may yet find personality correlates and individual differences in the PSR data.

A final important finding is that there was no evidence of a normal "gambler's fallacy" type of anticipation effect found in this experiment. I was concerned about this possibility from the start, and recently several researchers have raised the same concern in print (Dalkvist, Westerlund, & Bierman, 2002; Wackermann, 2002), however there was no sign of it in the large data set of this project where it might be expected. This raises the hope that the theoretical artifact may not be as serious as feared in previous experiments.

Recommendations

This project raises a number of important questions for future research. Among the more urgent is to further examine the role of stimulus content in the elicitation of PSR effects. There are suggestions from other research (e.g., Bierman & Scholte, 2002) indicating that different types of arousing material may elicit different PSR. In the present experiment, the IAPS arousing slides included both those that were arousing in an attractive way (e.g., erotic images) and those that were arousing in a negative way (e.g., mutilated bodies). Continuing analysis of the present data (outside the scope of the present grant) may provide clues.

Another important question concerns the nature of the PSR effect: Is it the gradual anticipatory rise preceding an arousing stimulus, as seemed to be the case from the averaged data of previous investigations, or is it an increased frequency of NS-SCRs, as May et al. (2002) and the present study has shown?

On the practical side, experience gained in the present study indicates that a higher level of pre-screening for general skin-conductive responsiveness should be employed in future research. It was my intention to sample with minimal pre-screening at this stage of PSR research, but for the future it will be more economical of time and possibly advantageous to the detection of any PSR effects to develop a screening regimen.

Expenses

A separate report of expenses, along with supplementary documentation is attached.

References

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SEEKING THE INTUITION RESPONSE

EXPLORING THE HUMAN ELECTRODERMAL "PRESPONSE" AS A RELIABLE INDICATOR OF PRECOGNITIVE INTUITION

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ABSTRACT: This project builds upon a series of experiments that demonstrate a human "presponse," an ANS response to *future* information. This experiment used skin conductance (SC) as the ANS measure and was designed to study test-retest reliability in what is now called pre-stimulus response (PSR). The experiment also examined the relationship between personality factors from the Myers-Briggs Type Indicator and the NEO-FFI tests.

Volunteer participants completed two sessions of viewing 40 calm and arousing images from the International Affective Picture System (IAPS) while SC was monitored. The PSR window was defined as 3 seconds before stimulus onset, and the measure of PSR was the area between the mean relative SC levels for the two classes of stimuli within the prestimulus window. Significance was determined using a Monte Carlo method. A novel analysis technique of de-trending the SC data immediately before the PSR analysis window was used to counter the possible effect of expectancy and other artifacts. Eighty planned subjects were tested. Sixteen were eliminated from further analysis because of lack of any SCRs, leaving 64 subjects in the final data pool.

The experiment did not produce overall evidence of a PSR effect, nor did it demonstrate test-retest reliability. Of three personality factors previously associated with better ESP scoring, MBTI Extraversion, MBTI Intuition, and NEO Openness, the last two were positively and significantly correlated with individual mean PSR. No evidence of an expectancy artifact was found.

Parapsychologists have long endeavored to find evidence of ESP in various physiological processes of the human subject. Usually these have been the autonomic responses, such as blood pressure or electrodermal activity (galvanic skin response). The attraction of physiological evidence comes from the belief that these may represent "more direct" evidence of ESP having taken place since ESP would have bypassed the elaborate cognitive and affective systems that might filter out, distort, or otherwise interfere with the accurate reporting of ESP as required by typical ESP tests.

Although early efforts to find physiological markers of ESP began in the early 1950s, it was not until the early 1960s that systematic work began. In a series of experiments Dean (Dean, 1962, 1966; Dean & Nash, 1967) claimed to find evidence for ESP between an agent and a subject in the plethysmograph recordings of the subject's finger pulse. Tart (1963) measured skin resistance, finger pulse volume and EEG of a subject while the agent (himself) either received an electric shock or did not (electric shock diverted to a resistor). Tart claimed evidence for ESP in that both the shock and no-shock conditions produced more responses in the subject than a corresponding control condition drawn from the inter-stimulus interval.

Schouten (1976) found evidence of ESP in both GSR and finger pulse volume in an experiment that included startling the agent with a loud sound and having the agent view names that were meaningful either to him or to the subject. Schouten concluded that the sensory stimulus (loud sound) produced a stronger ESP response in GSR while the emotional names seemed to affect finger pulse volume more.

Taking a different approach, Levin and Kennedy (1975) examined contingent negative variation (CNV), a slow brainwave potential just prior to making a voluntary act, in an experiment in which subjects were expected to respond with a key press to a green light, but not a red one. A random number generator determined which light would come on. Significantly larger CNVs were observed before the RNG selected the green lamp when compared to the red lamp suggesting that subjects were using ESP to anticipate the correct light.

Hartwell (1978) conducted a more complex version of the CNV study with promising, but non-significant results.

In addition to these studies, other studies reported failures to find expected effects and, in general, the quest for physiological markers of ESP remained inconclusive. In hindsight, it would appear that much of this research was unrealistically optimistic regarding the statistical power of the evaluation methods used to detect the psi effects.

In the field of psi research, attention moved from using psychophysiology as a detector of ESP to using it as a target in apparent psychokinesis experiments. Eventually known as DMILS (distant mental influence on living systems), this line of research, generally associated with the work of William Braud (See Braud & Schlitz, 1989) demonstrated that persons ("influencers") could intentionally alter the GSR of a distant subject.

Intuition: Precognition as a human ability.

Although most people have a working notion of "intuition," and the topic is often the centerpiece of business training seminars, psychology has only a vague idea of what intuition actually is. Some psychologists, following Jung (1976/1921), regard intuition as one of the four basic mental functions (along with sensation, feeling, and thinking) and see it as the direct perception of possibilities and implications inherent in a situation. Others see intuition as a talent for rapid assessment of information resulting in correct judgments without conscious awareness (e.g. Hebb, 1946). Still other psychologists, such as Wescott (1968) and Agor (1986) have focused on the practical nature of intuition in day-to-day decision-making, especially in the business world.

Drawing on the work of Wescott (1968) I have elsewhere provided a description of the chief components of what may be called practical intuition (Broughton, 2000b). These are:

Information in conscious awareness—what one knows about a given situation.

Information not within conscious awareness. This includes past information acquired either consciously (as in reading something) or unconsciously (as in an overheard conversation) as well as contemporary information gathered unconsciously such as sensing the emotional state of a colleague.

An ability (perhaps more highly developed in some people) to synthesize this unconscious and conscious information and assess outcome probabilities in an unconscious manner.

While this list may account for much of what is seen as intuition, decades of research in parapsychology suggest that this list in incomplete. Among the most common and most dramatic types of spontaneous psychic experience is that of *precognition* or "seeing the future." History records many famous examples and contemporary case collections (e.g. Rhine, 1961; Rhine, 1969) offer less famous but equally compelling examples. Although many of these cases involve dramatic dreams or visions of future events, the greater proportion of them are in the form of strong hunches or feelings that lead to a certain course of action. Rhine (1962) specifically labels these cases as "intuitive" and notes that they are the most common form of spontaneous ESP that occurs in the awake state. Stevenson detailed examination of "impression" cases supports the notion that ESP information comes in the form of intuitive-like experiences (Stevenson, 1970). Thus, added to the list of components of practical intuition should be a degree of precognitive ESP, at least for some persons.

Laboratory evidence for precognition is very robust. Honorton and Ferrari performed a careful meta-analysis of 309 precognition studies from 62 different investigators and found overwhelming evidence of precognition ($p = 6.3 \times 10^{-27}$). Their analysis demonstrated that variations in experimental quality or selective reporting could not explain away the results. Combining the experimental evidence of hundreds of studies with the rich collection of spontaneous experiences provides strong support to the conclusion that humans can acquire and act upon information from the future.

Elsewhere I have argued that psi ability should be viewed in an evolutionary context, where it stands side-by-side with all the other remarkable abilities and faculties of human consciousness (Broughton, 1988). Evolution has endowed humans with unmatched information gathering and processing capabilities which have brought the species to where it is today in an extremely short span of evolutionary time. Precognitive intuition—seeing the future—is probably just one of the components of this complex system. Given this perspective, the dramatic examples of precognition that attract our attention—dreams of disaster, for example—may be exceptions to the "normal" functioning of precognition. The normal operation of ESP may involve small amounts of useful information that arrive below the level of consciousness. Schmiedler (1988) has observed that precognitive perceptions generally do not seem to reach the level of conscious awareness. Such a process, when recognized at all, would feel like intuition as it is commonly understood.

The Intuition Response: Precognition and Psychophysiology

Recently Dean Radin introduced a new method for using human physiological response to detect precognition (Radin, 1997). Radin's method makes use of one of the strongest autonomic reactions, the orienting response, a set of psychophysical changes experienced by an organism facing a "fight or flight" situation. In humans the physiological reactions include dilation of the pupils, increased sweating, heart rate changes and vasoconstriction. The orienting response is easily induced in the laboratory simply by startling a subject with a frightening or noxious stimulus.

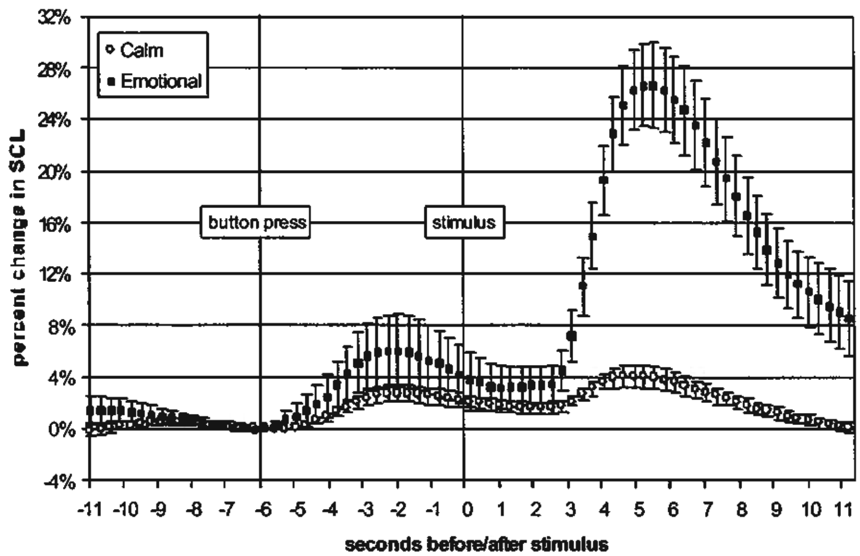

Figure 1. Superposed epoch analysis of one subject's results. This person viewed 8 emotional and 21 calm pictures. The two curves show the percent change in skin conductance level averaged over all calm and emotional trials, with one sigma error bars. (Reproduced with permission.)

Using the orienting response, Radin designed an elegantly simple method for detecting precognition or *presentiment*, as he called it to acknowledge the emotional nature of the process. In Radin's experiment a subject sits comfortably in a chair positioned to view pictures on a computer screen. Electrodes are attached to the fingers to measure skin conductance and, in some experiments, a photoplethysmograph was attached to measure heart rate and blood volume. A computer presents a random selection of either calm or emotional targets. The calm pictures are as one might expect, but the emotional pictures can contain mutilated bodies, violence and erotic images. The pictures are drawn from the International Affective Picture System (Bradley, Greenwald, & Hamm, 1993), a large collection of standardized photos developed for psychophysiological studies of emotion. As expected the calm pictures elicit little or no orienting response but the emotional pictures elicit a pronounced orienting response.

These responses are perfectly normal and expected. Radin's analysis, however, went further. He looked at the five seconds that *preceded* each picture exposure. Using a technique called superposed epoch analysis Radin examined the results of the emotional trials and the calm trials from 5 seconds before the picture was shown to 10 seconds after the three-second exposure of the picture. What Radin typically found was that just prior to the exposure of a picture skin conductance would begin to rise, but it rose far more just before the emotional pictures than before the calm pictures even though the subject had no normal way of knowing which type of picture would appear. Figure 1 illustrates this for one subject in a recent experiment.

Radin published the results of his first experiments in 1997 (Radin, 1997). In four studies the orienting "pre-sponse" (as it was termed) was significantly in evidence. Radin also presented evidence rejecting a number of possible artifacts, and shortly after Dick Bierman published an independent replication (Bierman & Radin, 1997). Subsequent significant replications by Radin (1998; 2000) have further refined the methodology.

Although it is still early days for the "orienting presponse" or presentiment effect, we can tentatively conclude that Radin's ingenuity, assisted by improved technology and analysis, has finally provided physiological evidence of psi function. Specifically, he has demonstrated that the human emotional system detects and begins to react to future potential threats even before those threats exist in fact.

Speculations on the Emotional Connection

It has long been known that the emotional significance of an event or a target (in an experiment) plays a role in ESP. Studies of the spontaneous case collections reveal that most often spontaneous ESP is associated with events involving anxiety and apprehension about significant others (Sannwald, 1963; 1979; 1981; Schouten, 1982). Ullman (1977/1986) notes that psychic dreams often involve situations where there is a potential threat to relationships with loved ones. Evidence from experimental research (Delanoy, 1989; Moss & Gengerelli, 1968) has shown that emotional targets are more likely to be successful than neutral targets in free-response ESP tests.

In a recent paper (Broughton, in press) I examined the principal types of spontaneous psychic experiences and found that the limbic system involvement may be a previously unrecognized common denominator in the genesis of such experiences. This seems particularly true for dreams, and for intuitive experiences, such as those studied by Stevenson (1970). Also, the largely ignored class of spontaneous cases in which persons experience anomalous bodily sensations (indicative of ESP) without cognitive awareness are relevant to research on somatic responses to precognitive information.

Radin's presentiment work brings the connection between our emotional systems and ESP into sharp focus. Could it be that the human emotional system plays an important role in the detection of psychic information? Parapsychologists have frequently speculated informally that this might be the case. Noted subliminal perception researcher Norman Dixon (1979) has explicitly argued that the limbic system is implicated in ESP.

While Radin's work has redrawn an important connection between precognition and the emotional system, recent work in neuropsychology has been showing that the brain's emotional system involves far more than just feelings and primitive responses. Antonio Damasio and colleagues have established that the human emotional system is tightly integrated with our decision-making systems, especially when those decisions involve our own futures (Bechara, Demasio, & Damasio, 2000; Damasio, 1994). Interestingly, in one of the studies by this team (Bechara, Damasio, Tranel, & Damasio, 1997) they observed anticipatory skin conductance responses prior to risky choices in a gambling task before the subject even realized that the choices were risky. Bierman (2000) has recently identified three recent experiments in conventional psychophysiology research that appear to show presentiment effects (For discussion, see Radin, 1998).

Elsewhere I have argued that we may have to reconsider our ideas about the information transmission properties of ESP (Broughton, 2000a). Because many spontaneous ESP cases appear to involve visual images or detailed impressions we have assumed that ESP involves relatively "broad band" transmission capable of conveying a large amount of information. There is little evidence to support this assumption, however. Even in the instances of apparently detailed ESP images, it is not possible to determine if the image is newly conveyed to the percipient, or if it is simply constructed by the percipient from suitable memories.

If continued research confirms and elaborates the role of the emotional system in ESP, then a more appropriate view of ESP ability may be that of a system which enhances decision-making (including, perhaps, early warning for fight or flight situations. ESP may operate by providing just enough information to the emotional system to bias critical decisions in a beneficial way. Even in apparently information-rich psychic experiences, it may be that ESP, working through the emotional system, biases memory recall in such a way to make the useful information available.

Experimental goals

The evidence so far indicates that the pre-stimulus response is the response of an individual's autonomic nervous system to future information. If that is the case, then we should expect individual differences in this response, as we find in all forms of human response and performance.

If there are individual differences in the pre-stimulus respons, can we begin to understand these differences and used this knowledge to improve human performance and well being, as we have with other areas of human activity (talent identification programs, job placement, etc.)? Consider, for example, what an understanding of individual differences in the pre-stimulus response might mean for job assignment in a police force or the military, or in the emergency room of a hospital?

Of course, any study of individual differences in human behavior involving ESP is likely to be a complex task. At the outset, we must consider that the path from pre-stimulus response to correct decision or helpful memory is undoubtedly a complex one. Not only are there likely to be differences in pre-stimulus respons, but there may also be differences in how that response is interpreted at the higher levels of the brain where interactions with personality or other factors might mitigate or enhance the utility of the pre-stimulus respons.

Before any of the many research possibilities can begin there is a basic datum that needs to be gathered: Are we dealing with a reliable human response? Without conventional evidence of reliability it will be difficult to convince fellow scientists that we are dealing with a human response to future information. Along with that it will be important to show that stable individual differences exist, both in terms of straightforward response differences between individuals and by demonstrating that these differences correlate with other aspects of human performance, behavior and personality.

The primary objective of this project was to establish the statistical reliability of the orienting "presponse" (anticipatory response) on a sufficiently large population using the skin conductance response obtained by accepted and widely practiced methods. Secondary objectives were to demonstrate measurable individual differences in the pre-stimulus response and to investigate whether the pre-stimulus response correlates with selected psychological instruments.

METHOD

Overview

The general design of this experiment involved having volunteer subjects participate in two sessions of a PSR experiment, using a methodology similar to that of Radin (Radin, 1997; 2000) and Bierman (1997). Tests were administered typically at one-week intervals, though that time varied according to individual requirements. Participants also completed the Myers-Briggs Type Indicator (MBTI) and the NEO-FFI personality assessments, prior to the PSR testing in most cases.

Subjects

Eighty-three subjects were recruited and tested. Three were discarded before analysis due to equipment failures early in the series, leaving the target number of 80 participants. Upon initial inspection of the skin conductance data, 16 subjects were found to have produced no responses in one or both sessions, i.e., no apparent skin conductance responses (SCRs) in a full session. These subjects were also discarded, leaving 64 qualifying subjects. The qualifying subjects consisted of 25 males and 39 females, ranging in age from 19 to 81 and with a mean age of 44.7 (SD = 14.8). Subjects were recruited primarily via word-of-mouth or appeals by the experimenter at various meetings or groups of interested persons. Subjects were not paid, but were given a formal report of their MBTI results for personal use. All participants executed an informed consent form prior to participation.

Apparatus

Skin conductance was measured using a PSYLAB model SC5-SA monitor and pre-amplifier system manufactured by Contact Precision Instruments of London, U.K. and Cambridge, MA[1]. The SC5 is a 24 bit digitizing monitor with 0.1 μSiemen absolute accuracy, better than 0.001 μSiemen relative accuracy, and a range of 100 μSiemens. It measures directly in units of conductance, using DC coupling with constant voltage excitation.

The SC5 unit samples at 40 Hz and outputs its data in real time via a standard RS232 serial connection to a computer.

Ag/AgCl electrodes of 8 mm diameter (MED Associates model TDE-022-48) were filled with an isotonic electrode paste (MED Associates type TDE 246 Skin Conductance Electrode Paste) equivalent to Lykken and Venables' (1971) "Unibase".

Emotional pictures were drawn from the International Affective Picture System (IAPS) (Lang, Bradley, & Cuthbert, 1995) and presented on the screen of a laptop computer as described below. To enhance the contrast between the calm and arousing images, only the top 220 and bottom 220 pictures on the arousal scale were used. There are separate scales for males and females in the IAPS system.

A laptop computer (Dell Inspiron 3800 with Windows® 98 SE operating system) was used both to present the images to the subject and to collect the skin conductance data. The controlling program was written in Visual Basic® 6 by Edwin May of

[1] Contact information is provided at the end of this paper.

the Laboratories for Fundamental Research and independently tested by the author. Picture selection was randomized using a hardware-based "true" random number generator (model rp1) that was attached to the parallel port. If the hardware RNG was not available, the program defaulted to a fail-safe mode that employed a high-quality pseudo-RNG (Marsaglia, 1995). Both RNG systems passed Marsaglia's DIEHARD randomness test and both were tested to confirm adequate randomization of the IAPS image set as used in this experiment. The procedure for determining pictures involved two steps. In the first step both a calm and an arousing picture are selected from the available pool and loaded into memory. Immediately prior to the stimulus presentation another random decision determines which of the two pictures will appear. This means that the random decision as to whether to show a calm or arousing picture is made only about a microsecond before the picture appears on the screen and there was no computer disk movement or other potential source of noise associated with the random decision.

Picture stimuli were presented to the subject for 3 seconds each with an inter-stimulus interval that varied randomly between 21 and 26 seconds. Images appeared approximately 13 x 17 cm in the center of a black screen.

Skin conductance data were collected continuously during the experimental period by means of standard Windows API routines. Input buffers were transferred to program data arrays at critical points in the program, for example, immediately prior to picture selection, for accurate synchronization of SC data with the picture events.

Personality assessment

The Myers-Briggs Type Indicator (MBTI) Form G was used with standard scoring sheets that were used in conjunction with a scoring program written by the experimenter. The scoring program checked for data entry integrity and stored results in a database. The MBTI was selected because of a history of demonstrated relationships between MBTI factors and ESP performance.

The NEO-Five Factor Inventory (NEO-FFI) Form S was also used. These were hand-scored by the experimenter. The NEO-FFI has shown some correlations between ESP performance and at least the "Openness to experience" scale and it has also been used in studies of emotional responses to the IAPS picture set.

Both personality tests were normally given to participants and completed prior to the IAPS test sessions although there were a limited number of exceptions to this.

Testing environment

In order to maximize the number of participants testing was offered with considerable flexibility in location and time. The equipment was portable, so, in addition to the facilities of Intuition Laboratories, subjects were tested in their homes or those of friends, and sometimes at their place of work. In some instances, a participant would organize a small group of friends to chat with the experimenter and take part in the experiment. In all cases, the actual test took place in a quiet room (away from any other people, if there were any) with comfortable viewing arrangements. In all cases, subjects took both the first and second tests in the same environment. Under these circumstances it was not possible to control closely temperature and humidity, but in all cases these were within the normal "comfort zone" for American households (20° to 25° C).

Testing procedure

After preliminary interactions, the experimenter would lightly wipe the first and second fingers of the participant's non-dominant hand with an alcohol wipe. The prepared electrodes would be fixed to the medial phalanx of these fingers with paper medical tape in a cross fashion to minimize constriction. A minimum of 10 minutes was allowed to elapse during which the experimenter explained the experiment and generally discussed its importance. The subject was seated in a comfortable chair at a convenient viewing distance from the computer screen. The experimenter then loaded the parameter file into the program and entered various session details. Next the program displayed a graph of the skin conductance and the experimenter provided a brief explanation and a demonstration by asking the participant to take a sharp, deep breath (which typically produced a noticeable deflection in the trace). The experimenter then reviewed the sequence of events that would follow and allowed the participant to experience a demonstration trial (always a calm image that was not used in the actual test). When the participant had no further questions, the experimenter reminded the participant to simply sit quietly and watch the pictures, breathing normally and avoiding any large bodily movements if possible. Then the experimenter started the program and left the testing room. At that point the program began collecting SC data and displaying the 40 randomly selected IAPS pictures. The testing time lasted about 18 minutes and on completion a message was displayed thanking and instructing the participant that the experiment was completed and to call the experimenter. No feedback of results was provided at this time, but the experimenter allowed the participant to express their reactions to the material (if they so chose) and answered any additional questions.

The second test session was held about a week later, although in some cases the interval was longer and, on rare occasion, shorter, when this was necessary to insure that the participant could complete both sessions. The time interval was not thought critical at this stage of the research. For the second session the explanation of the experiment was in the form of reminding the participant what would take place and the demo trial was not used. Each test session used a fresh random sequence of images, so participants saw a different series of pictures on the second visit (apart from any that might have randomly come up in the first session).

After the second test session was completed the experimenter provided the participant with his or her MBTI and NEO-FFI reports with a short explanation of the results.

Hypotheses and planned tests

The two principal hypotheses were (1) that the combined data of all sessions would demonstrate significant evidence of a pre-stimulus effect using the epoch analysis method (difference in area between the arousing SCR level and the calm SCR level in the prestimulus area), and (2) that there would be a positive correlation between the prestimulus responses of the two test sessions for the subjects. Hypothesis 1 would demonstrate a replication of previous work and hypothesis 2 is expected on the basis of the nature of human abilities (although replicability in psychological tests is not as reliable as some suppose (see, for example, Kindt, Bierman, & Brosschot, 1996).)

It was hoped that one or more of the various personality factors derived from the two tests would show a relationship with subjects' average prestimulus response.

In previous standard ESP testing, MBTI factors E (extraversion) and N (intuition) have been shown to be associated with positive scoring (Broughton, Kanthamani, & Khilji, 1989; Honorton, Ferrari, & Bem, 1990), and ganzfeld testing had shown persons with the MBTI profile of ENFP to be good scorers (Honorton, 1992). In the NEO-FFI, only the O (openness to experience) had been associated with good ESP scoring (Broughton & Alexander, 1996). It was, therefore, expected that these personality factors might show a positive relationship with PSR.

Data reduction and analysis

Data reduction and analysis was conducted in close collaboration with Edwin May and James Spottiswoode of the Laboratories for Fundamental Research who were engaged on a similar project. In this context "we" refers to the combined efforts of this group.

The original method of analyzing prestimulus response experiments was to average all arousing trials for all participants and compare the resulting averaged response with the averaged response for the calm trials. Prior experiments defined the prestimulus period as 5 seconds before the start of the stimulus presentation. For a number of reasons, we decided not to follow exactly the original analysis method.

Early in the research project we identified two sources of potentially serious bias that could artifactually create the appearance of a PSR. The first is an expectancy artifact and arises from the possibility that skin conductance level (SCL) could respond in a manner similar to the "gambler's fallacy" in which a gambler thinks that a win is more likely to happen after a string of losses. In PSR experiments, after a calm image it is possible that a participant's SCL begins rising (as a result of anxiety) in anticipation of an unpleasant arousing image. Successive calm images could cause anxiety (and thus SCL) to rise considerably. In contrast, after an arousing image, the participant might relax (lowering SCL) in anticipation of a calm image. Under these conditions, a fortuitous arrangement of calm and arousing stimuli could result in these normal reactions simulating a PSR effect.

This potential source of bias has been a concern since early in presentiment research and Radin did various simulations to demonstrate that it was not a problem in his research (Radin, 1997). Bierman (1999) subsequently provided a proof that the expectancy artifact was not a problem in properly randomized experiments with large numbers of trials. More recently Dalkvist, Westerlund and Bierman (2002) have demonstrated that the expectancy bias remains a serious problem through elaborate simulations of PSR studies in which the data of individual test sessions were combined in different ways. Dalkvist et al. observed, however, that when data are averaged for the arousing and calm conditions across all subjects, the bias is not a problem. (This is how most studies to date have been done.) Wackermann (2002) has provided a mathematical treatment of the bias (and also notes that Bierman's proof is invalid).

A second source of bias is a position effect. In experiments monitoring skin conductance it is normal for the participant's SCL to start at a certain level and rapidly drop off in the early part of the test session as the participant relaxes and gets used to the experiment. As the session goes on, the rate of fall in SCL typically decreases. If chance should cause a greater proportion of calm trials to fall in the early part of the test, when SCL is dropping rapidly, and the arousing trials come toward the end, when SCL is dropping slowly, the average of the PSR regions for the calm trials would appear to be lower than the average for the arousing trials. This could be incorrectly interpreted as a PSR difference between calm and arousing trials.

The position effect bias has not previously been treated with regard to the PSR research, although it is similar to the problem identified by Millar (1976) in his critique of Schmeidler's work with PK effects on thermistors.

To deal with both types of artifact, May and Spottiswoode developed a method of analysis in which any trend in the data (up, for example, in the case of expectancy, or down in the case of position artifacts) is removed through a curve-fitting technique immediately prior to the pre-stimulus window. With the trend removed, data are clamped to zero at the start of the prestimulus window and the prestimulus response is defined as the area under the curve defined by the relative skin conductance difference (see Figure 2). A detailed explanation of this analysis method can be found in Spottiswoode and May (2002).

Pilot explorations with data from similar PSR experiments led to the specification of two additional thresholds for inclusion of PSR data. The pilot data revealed that the PSR "effect," which, if real, is very small, and is very sensitive to non-specific SCRs (NS.SCR) that can occur normally throughout the session, due to the participant moving slightly or just taking a deeper than normal breath. It is not possible to identify and remove these artifacts manually, so two criteria were developed for automatic exclusion. Any changes in the slope of the SCR line within the prestimulus area that fell within the top 2.5% of positive or negative deflections (most extreme 5% of changes in slope) caused the trial to be discarded. Similarly, any shifts in skin conductance level that fall within the top 2.5% of positive and negative excursions (5% total) were excluded as likely artifacts. The cutoffs were derived by examining all slope changes and level changes in the qualifying trials, excluding the prestimulus region and 10 seconds following the presentation of the stimulus. For further details see May et al. (2002).

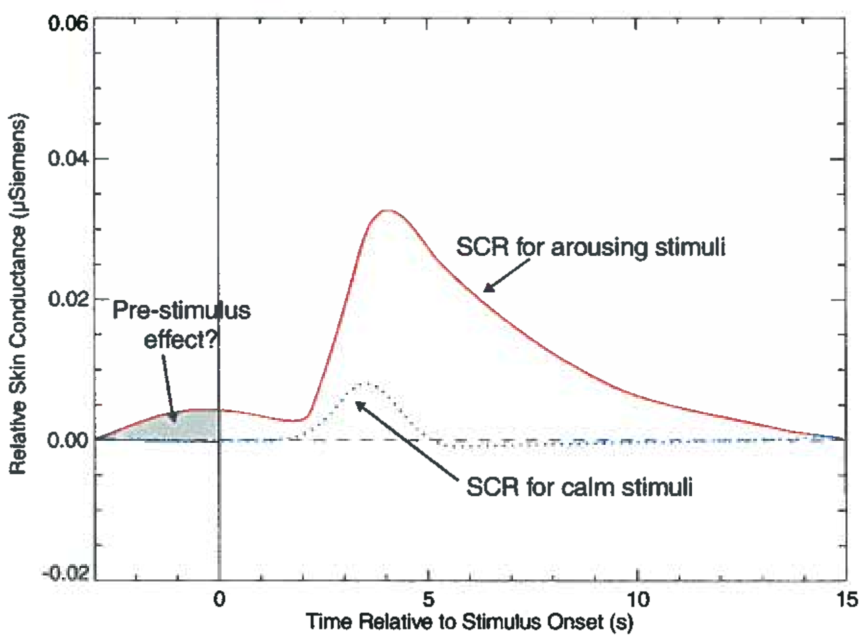

Figure 2 Idealized example of skin conductance responses for different stimuli illustrating possible prestimulus response effect.

The pilot explorations also revealed that the most efficient window in which to look for a presentiment effect using the curve-fitting approach was 3 seconds before the stimulus onset. This is different from the PSR window used by previous researchers who typically used a 5 second window.

Post-stimulus response amplitudes were computed in the standard way. Only SCR amplitude was used for examination of post stimulus responses.

Lability measures for each subject were calculated by counting the number of NS.SCRs outside the prestimulus window and 10 seconds post stimulus and dividing this by the number of seconds, yielding a NS.SCR/second value.

May, Vassy and Spottiswoode (2002) have also developed an additional measure for examining prestimulus response. This is simply to count the number of NS.SCRs in the prestimulus window and compute a simple ratio of the average number of NS.SCRs for the arousing condition over the average number of NS.SCRs for the calm condition. The resulting ratio is tested against the expected ratio of 1.0. Elsewhere they have argued that this may be a better method of analysis for PSR (REF).

The planned hypotheses were to be tested as follows. Hypothesis 1, that there would be overall evidence of a PSR effect, would be tested by averaging the arousing trials and the calm trials for all subjects using the curve-fitting method in the prestimulus window of –3 to 0 seconds and computing the difference in area under the curves. This is called the prestimulus area difference (PAD) and the analysis method is also known as an epoch analysis. The significance of that difference would be determined by a 20,000 pass Monte Carlo simulation that randomly re-assigned arousing and calm labels to responses. Hypothesis 2, that there would be a positive correlation between participant performance across the two test sessions would be tested using a Spearman correlation on the *z*-score based on the PAD for each test session.

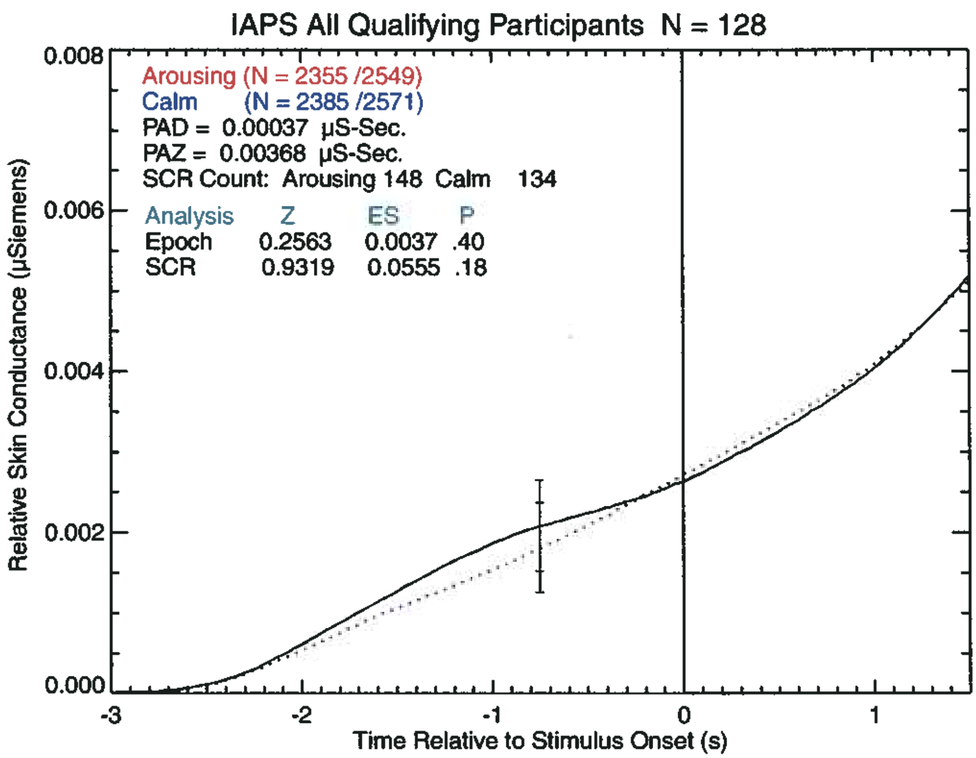

Figure 3. Epoch analysis of 128 sessions. Dashed line is for calm stimuli. N's for each condition represent the number of trials after filtering out of the total number of trials.

RESULTS

Hypothesis 1 was not confirmed. In fact, there was no evidence of a PSR effect using the planned measure. The Monte Carlo analysis of the overall PAD from the 128 sessions (2 from each of the 64 qualifying participants) yielded a $z = 0.26$ (ns). Figure 3 presents the results.

May and Spottiswoode's alternative method of evaluation based on the NS.SCRs in the prestimulus window yields a slightly better, but still completely non-significant $z = 0.93$.

Hypothesis 2, that there would be a correlation between participants' test sessions, as measured by their individual PAD scores, was not confirmed either, $r = -.12$ (df 62, $p = .35$).

To examine the relationship between individual PSR results and the personality tests, a mean z was computed based upon the z-scores associated with the two PAD results for each participant. The continuous scores from the four factors of the MBTI test and the T-scores from five factors of the NEO-FFI were used. Of the seven items, the MBTI SN (sensing-intuition) scale showed a positive and significant correlation with PSR, $r = .29$ ($df = 62$, $p = .021$), as did the NEO Openness scale, $r = .32$ ($df = 61$, $p = .012$). Table 1 shows all correlations. Figure 4 displays the scatterplots for the two factors with significant correlations.

Table 1
Personality factor correlations with pre-stimulus response

Factor	*Pearson r (p)*
MBTI Extraversion-Introversion	–.13 (.29)
MBTI Sensing-Intuition	.29 (.02)
MBTI Thinking-Feeling	.05 (.70)
MBTI Judging-Perceiving	.08 (.52)
NEO Neuroticism	–.14 (.26)
NEO Extraversion	.07 (.57)
NEO Openness	.32 (.01)
NEO Agreeableness	.04 (.74)
NEO Conscientiousness	.04 (.73)

Notes: MBTI tests have 62 df, NEO have 61 df (one person did not complete). MBTI E-I scale puts introversion high, thus a negative sign indicates a positive correlation with extraversion. Probabilities are not corrected for multiple analyses.

As noted by Kindt et al. (Kindt et al., 1996) test-retest reliability in psychology is frequently assumed rather than demonstrated. Accordingly it seemed appropriate to test the reliability of the *normal* components of the SC response to calm and arousing IAPS pictures. To assess normal reliability I computed the mean relative amplitude of the SCRs for calm and arousing stimuli and the difference between the mean amplitudes for each test session. These measures from the two sessions of each participant were tested in Pearson correlations ($df = 62$ in all cases): Calm amplitude, $r = .47$ ($p = .00009$); Arousing amplitude, $r = .44$ ($p = .0002$); Amplitude difference, $r = .32$ ($p = .009$).

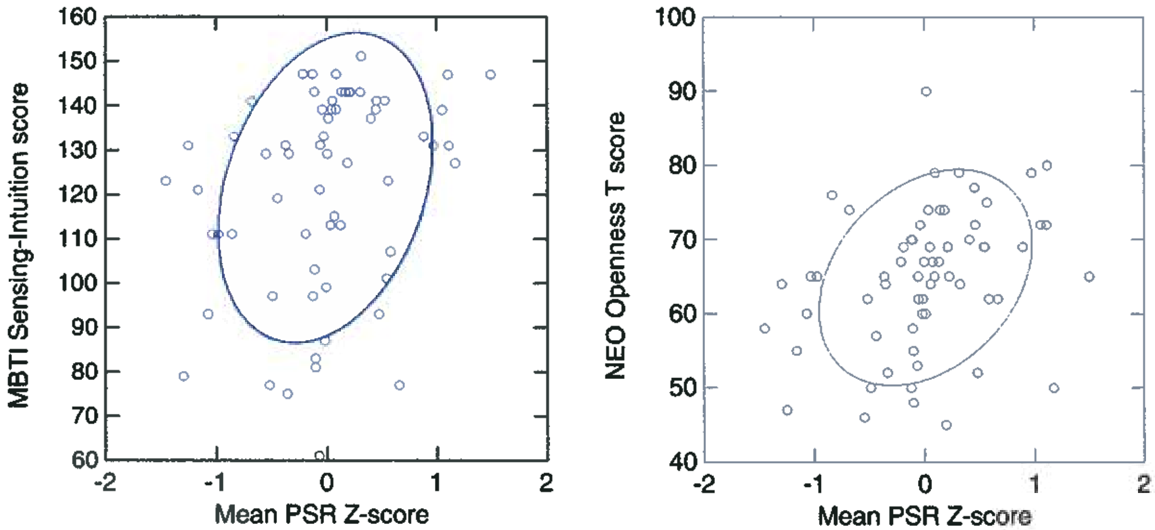

Figure 4 Scatterplots for correlations between mean PSR score and MBTI Sensing-Intuition factor (left) and NEO Openness factor (right).

Decomposing the PSR

In a similar experiment using loud audio stimuli for the arousing condition, May, et al. (May et al., 2002) has demonstrated that the principal component of the anomalous PSR is one or more NS.SCRs that occur in the pre-stimulus region of each trial, not the gradual rise in SCL that seems to be the effect in prior research. The apparent rise in SCL may simply be the consequence of averaging many NS.SCRs that occur more frequently before arousing than calm stimuli. To examine the effect of NS.SCRs in the prestimulus region, I compared the basic epoch analysis for those sessions in which there was at least one NS.SCR in the prestimulus region of either a calm or an arousing stimulus with the same analysis done on sessions with no NS.SCRs in the prestimulus regions. The results are shown in Figure 5.

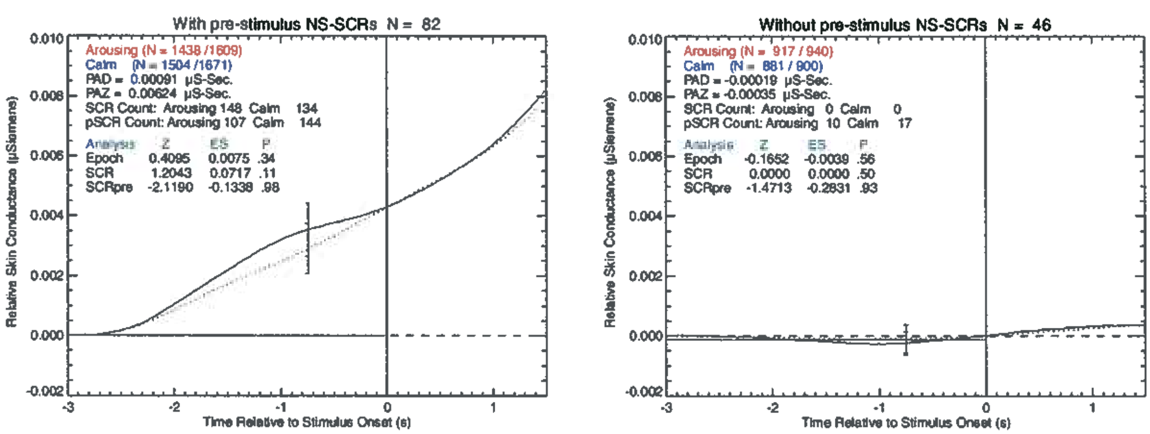

Figure 5. Epoch analysis using trials with NS.SCRs in prestimulus region (left), without NS.SCRs (right). Dotted line represents calm stimuli.

Inspection of the two plots reveals a striking difference. When there are no NS.SCRs in the prestimulus region, there is no increase in SCL prior to either calm or arousing trials.

EXAMINING NORMAL EXPLANATIONS

The overall results of the experiment did not provide a significant confirmation of the hypotheses, yet it is still prudent to examine potential normal explanations for any results obtained.

Randomness of stimuli

Although the true RNG passed exhaustive acceptance tests, it is also necessary to examine its performance in the actual runs used in the experiment. A Wald-Wolfowitz Runs test was applied to the calm-arousing sequences for each of the 128 sessions used. Of the 128 *z*-score results, four were significant, three exceeding the .05 level of significance and 1 falling at the .01 level, which is within normal expectation, indicating that the stimuli conditions were allocated randomly.

Normal expectancy (gambler's fallacy)

Renewed attention has been drawn to the possibility that a form of normal human expectation may artifactually simulate PSR, particularly when using epoch analyses (Dalkvist et al., 2002; Wackermann, 2002). This expectancy artifact, a physiological equivalent of the gambler's fallacy, would show up as a increased SCL in anticipation of an arousing stimulus. Thus as the interval between successive arousing stimuli grows, the SCL would continue to rise. While theoretically plausible, there has not yet been any large-scale empirical tests. This project offers the opportunity for a suitable test.

Although the experiment did not provide evidence for PSR there is no reason to suppose that it should be any less susceptible to the expectancy artifact. To test for evidence of an expectancy artifact I computed a prestimulus area from zero (PAZ) score representing the area between the SC line and the zero clamping line in the prestimulus region for each trial. For the arousing trials only, I computed a Spearman correlation between the PAZ for the arousing trials and the number of seconds since the last arousing trial (or the start of the experiment where necessary). If an expectancy artifact is present, it should manifest as a positive correlation between PAZ and the time between arousing stimuli.

For the data as used in this experiment, which was de-trended to remove any expectation bias and filtered to remove potentially artifactual NS.SCRs, the result was $r_s = .016$ ($df = 2353$, $p_{1\text{-}tail} = .21$). To test the potential effect of an expectancy artifact on more typical data, the PAZ score was computed without de-trending or artifact filtering and used in the Spearman correlation. The result was $r_s = .003$ ($df = 2547$, $p_{1\text{-}tail} = .44$). This result is shown in Figure 6 since it represents a clear test of the expectancy effect hypothesis. Finally, May and Spottiswoode's alternative method of analysis using the ratio of NS.SCRs was tested by using the count of NS.SCRs before an arousing stimuli instead of the PAZ score. The result was $r_s = .013$ ($df = 2547$, $p_{1\text{-}tail} = .25$). In all three tests there was no evidence of an expectancy artifact.

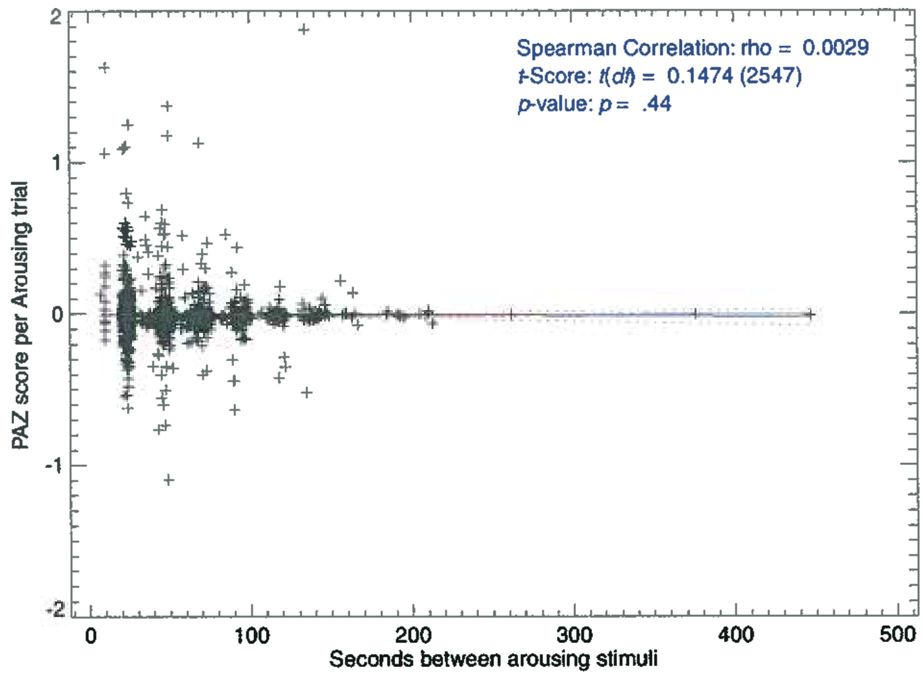

Figure 6. Spearman correlation of PAZ scores for arousing trials with number of seconds before an arousing stimulus. The blue line is the expected correlation by chance and the solid red line is the observed correlation. Dashed lines are 95% confidence interval.

Discussion

This experiment clearly failed to replicate previous experiments that have used a similar design. Since there were a number of differences in the way this experiment was analyzed when compared with previous work, an obvious issue is whether the original method of analysis would have been preferable. The original method used a 5 second PSR window and used simple ensemble averaging rather than the curve-fitted de-trending used here. The simple answer is no, as shown in Figure 7.

Over the various experiments there has not been uniformity in stimuli selection. Some previous experiments have used IAPS images mixed with similar images from unspecified sources, while others have explicitly replaced some of the IAPS pictures (erotic images, for example) with more extreme versions tailored for local conditions. In this experiment I deliberately wanted to stay with the well-tested standard set. It is clear from Figure 7 that the IAPS images had their intended effect on the normal post-stimulus response, so it would be difficult to argue that they were not appropriate for testing the prestimulus effect.

The overall results raise several questions that are pertinent to future research. The experiment failed to detect the hypothesized difference between the PSR for arousing stimuli and for calming stimuli, but Figure 2 suggests that this may be because *both* types of stimuli are preceded by an *apparent* PSR. Could this be an artifact induced by the de-trending procedure—a form of rebound? Figure 5 demonstrates that it is not a result of the de-trending because in the absence of NS.SCRs, there is no apparent SCR. Figure 5 confirms the observation of May et al. (May et al., 2002) that the fundamental component of a PSR effect is the NS.SCR. Obviously it is not justifi-

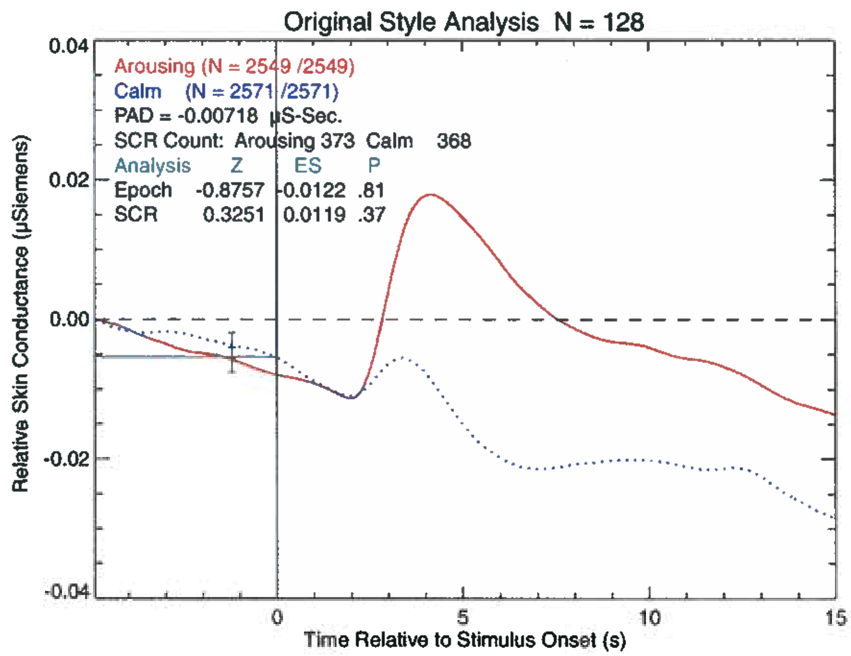

Figure 7 Results of this experiment if it had been analyzed using the "traditional" method. Dashed line represents calm stimuli.

able to suggest that both conditions are exhibiting PSR, since that would be inconsistent with considerable prior research, but that possibility cannot be ruled out and further research is required.

Of the seven personality factors investigated in this experiment, three have previously been identified as being associated with better scoring in ESP experiments. All three were correlated in the expected direction and two of them, MBTI Intuition and NEO-FFI Openness, were correlated significantly with PSR. Even as one-tailed probabilities they would not survive a correction for multiple analyses, however this result is a promising indication that experiments with more robust evidence of PSR may reveal personality relationships consistent with previous ESP research.

One of the useful findings to emerge from this experiment is that it provides strong evidence that the hypothesized expectation artifact may not be as serious a problem in practice. The complete lack of even a suggestion of a correlation between arousing trial PSRs and the duration from one arousing to the next arousing stimuli indicates that the participants in this experiment were not displaying the anticipation strategies proposed by Dalkvist et al. (2002).

Although this experiment failed to confirm the hypotheses it set out to test, it has managed to apply some promising new tools for the continuing investigation of the prestimulus response to emotionally charged materials. Future research should address the relationship between the NS.SCRs and the gradual SCL increase previously taken as the indicator of PSR, as well as the role of the affective content in the stimuli that are used in these experiments.

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SOURCES

SCR equipment: Contact Precision Instruments Inc., P.O. Box 425605, Kendall Square, Cambridge MA 02142. http://www.psylab.com/ .

True RNG model rp1: Rolf Freitag, University of Ulm, Dept. of Semiconductor Physics, Albert-Einstein-Allee 45, 89069 Ulm, Germany.

Electrodes, paste: MED Associates, Inc. P.O. Box 319, St. Albans, VT 05478. http://www.medassociates.com/ .

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Bial Bursary 52/00

Seeking the Intuition Response

Exploring the human electrodermal "presponse" as a reliable indicator of precognitive intuition

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Introduction

Traditionally psychology has described intuition as having several components:[1,2]

- Information in conscious awareness.
- Information in memory, no longer easily accessible to consciousness.
- An ability, perhaps more developed in some people, to synthesize conscious and unconscious information and assess outcome probabilities unconsciously. (Damasio has recently highlighted the role of the emotional system in this process.[3])

Decades of research in parapsychology[4-6] suggest that there may be an additional component—extrasensory perception, including precognition,[7] which is likely to be tightly integrated with other cognitive abilities by evolutionary design.[8]

The Intuition Response: Precognition and Psychophysiology

Radin has introduced the use of the orienting response to detect emotional responses to future information.[9-11] In a typical experiment, subjects view a series of calm or emotional pictures while their physiology is monitored, primarily skin conductance (SC). Radin found that, in addition to the expected orienting response, there was significant evidence of a *prestimulus* response (PSR), which he called the "presentiment effect," several seconds *before* an arousing stimulus was displayed. This has been replicated at other laboratories[12] and may even be present in mainstream research.[13]

Is the PSR a reliable indicator of intuitive ability?

The primary objectives of this project are:

- Examine PSR test-retest reliability.
- Look for individual differences in PSR performance as related to psychological correlates.

Methods

Skin conductance measured by Psylab SC5A[14] using standard methods.[15] Stimulus pictures drawn from International Affective Picture System (IAPS)[16] using upper and lower thirds of arousal dimension for contrast.

Personality dimensions are measured by NEO-FFI and MBTI.

A test session consists of 40 stimuli, randomly selected from calm and arousing IAPS pictures. Each participant contributes two test sessions approximately one week apart.

Skin conductance responses are scored by proprietary software developed by the Laboratories for Fundamental Research. It uses linear fitting algorithms for maximum sensitivity and *thorough artifact rejection*. (See poster *Prestimulus Response with and without a Sender.*)

Results (preliminary, 78 of 80 planned participants)

Prestimulus response, Z-normalized scoring.

- Combined sessions, 156/160 completed: $Z = 1.39, p = .08$
- First sessions only, 78/80: $Z = 1.73, p = .04$
- Second sessions only, 78/80: $Z = 0.25, p = .40$

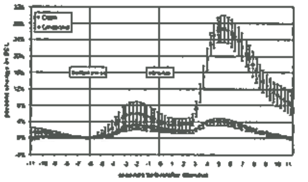
Test-retest reliability on prestimulus responses:

- Z-scores from first/second sessions: $r = -.10, p = .37$

Personality measure analyses are still pending.

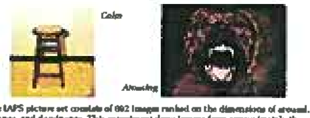
Interpretation (preliminary)

With 78 of the planned 80 subjects completed, it appears that the participants' sessions are providing a confirmation of the PSR effect, but the second sessions are not. The combined results are in the expected direction, but not significant. Examining the graphs suggests that the arousing stimuli are producing a PSR effect, but so are the calm stimuli. As a result, the difference between calm and arousing pictures is not significant, especially in the second session. The lack of test-retest reliability is disappointing, and may be due, in part, to the lack of any PSR in the second sessions.



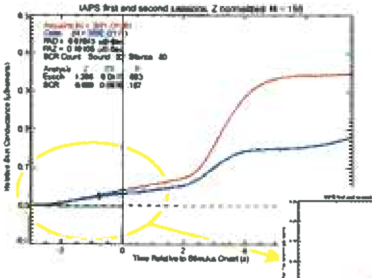
Example from Radin[11] Superposed epoch analysis of one subject's results. This person viewed 8 emotional and 21 calm pictures. The two curves show the percent change in skin conductance level averaged over all calm and emotional trials, with one sigma error bars. (Reproduced with permission.)

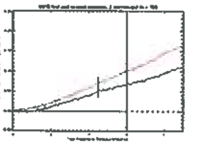
IAPS picture examples

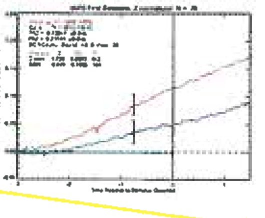


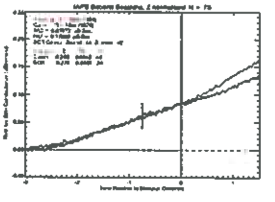
The IAPS picture set consists of 692 images ranked on the dimensions of arousal, valence, and dominance. This experiment drew images from approximately the upper and lower thirds of the arousal dimension.

Example of a typical experimental setup. IAPS pictures are randomly displayed on a laptop computer while skin conductance is monitored. Image is on the screen for 3 seconds.









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