Europe's Journal of Psychology
ejop.psychopen.eu | 1841-0413

PsychOpen publishing psychology

Research Reports

Context-Dependence, Visibility, and Prediction Using State and Trait Individual Differences as Moderators of ESP in a Ganzfeld Environment

José Miguel Pérez-Navarro*[a], Katharine Cox[a]

[a] University of Greenwich, London, United Kingdom.

Abstract

In this paper we present a method for participant classification, based on trait and state, in the experimental evaluation of ESP (extrasensory perception). We conducted three Ganzfeld experiments with a sample of 237 participants. In experiment I (N = 60) twenty participants ranked the target stimulus in the first position, achieving a non-significant rate of correct guesses of 33.3% (z = 1.48, p = .07, one tailed). In experiment II (N = 90) only 26.6% of the participants' guesses were correct (z = .35, p = .36, one tailed). Weighting trials in the second experiment on the basis of the most successful predictors of the participants' performance in the first experiment increased the rate of correct guesses from 26.6% to 36.4%. Results in a confirmatory experiment (N = 87) were not significant (32.7%, z = 1.32, p = .09, one tailed). However, overall results in this study were consistent with the effects sizes data reported in previous meta-analyses.

Keywords: Ganzfeld, sensory attenuation, ESP, parapsychology, perception

Europe's Journal of Psychology, 2012, Vol. 8(4), 559–572, doi:10.5964/ejop.v8i4.507

Received: 2012-08-07. Accepted: 2012-09-27. Published: 2012-11-30.

*Corresponding author at: University of Greenwich, Department of Psychology and Counselling, School of Health and Social Care, Avery Hill Road, Eltham London, SE9 2UG, United Kingdom, email: josemiguel.navarro@unir.net

A diversity of explanations has been put forward in response to traditional claims of ostensible paranormal experiences. Sceptical researchers explain experiences like extrasensory perception (ESP) in terms of 'normal' psychological mechanisms such as misinterpretation of statistically infrequent events and coincidences (Blackmore & Trościanko, 1985; Wierzbicki, 1985), illness (Goulding, 2004; Williams & Irwin, 1991), or mere lying or fantasising by the individual (Russell & Jones, 1980). However, there are also researchers who argue that some of these reports might actually reflect a genuine human capability of communication that appears in a subtle, sporadic, and uncontrollable manner (Bem & Honorton, 1994; Parker, 2000; Utts, 1991). These contrasting views have stimulated intense debate in the area, like the Hyman and Honorton debate in the eighties and nineties (Bem, 1994; Bem & Honorton, 1994; Honorton, 1985; Hyman, 1985, 1994; Hyman & Honorton, 1986), or the more recent psi-Ganzfeld debate (Bem, Palmer, & Broughton, 2001; Hyman 2010; Milton & Wiseman, 1999, 2001, 2002; Storm & Ertel, 2001; Storm, Tressoldi, & Di Risio, 2010a,b).

The experimental procedure most commonly used nowadays in parapsychological research is the Ganzfeld technique, a sensory monotonisation technique originally used for the study of perception by Gestalt psychologists (e. g. Avant, 1965). The adoption of this paradigm in the area derives from the *Noise Reduction Theory* (Honorton, 1977, 1978). In this theory, ESP is conceptualised as a weak signal that is frequently masked by internal somatic and external sensory 'noise'. Reducing the signal-to-noise ratio should therefore help detect any ESP signal, and this can be achieved by reducing internal and external stimulation.

Ganzfeld experiments commonly involve two participants (one in the role of a telepathic sender and the other of a receiver) located in separate rooms. The receiver is placed in a sensory attenuation environment. The individual lies back in a comfortable reclining chair listening to white noise through headphones during all the session. Visual attenuation is achieved by placing translucent acetates (normally ping-pong ball halves) on the individual's eyes. The participant is asked to keep his/her eyes open all the time looking at the light so that all he/she can see is a homogenous pink field in front of him/her. The individual is asked to try to relax and report spontaneous mental images, feelings, and subjective impressions that come into his/her mind. In the meantime, the sender, in a separate room, is shown a target stimulus such as a picture, postcard or video clip that has been randomly selected from a large pool of possible targets. The sender is asked to "silently communicate" this target to the receiver. Then, a randomly ordered target set containing the actual target and three decoy stimuli are shown to the receiver, who is asked to rate the degree to which each matches the thoughts, feelings, and images he or she experienced during the response period. Using the direct-hit measure of scoring, as opposed to the sum-of-ranks measure, the receiver scores a *hit* if he or she chooses the actual target and a *miss* if he or she selects a decoy. By chance alone, receivers should select the actual target 25% of the time. A statistically significant deviation above this baseline is taken to indicate a communication anomaly.

Previous studies based on this technique vary widely in their degree of support for the ESP hypothesis. Certainly, impressive results have been reported using selected populations, such as art students (e. g. Morris, Cunningham, McAlpine, & Taylor, 1993; Morris, Dalton, Delanoy, & Watt, 1995; Schlitz & Honorton, 1992), and meta-analyses show a small, highly significant effect of information transfer between sender and receiver that cannot be explained by any form of sensory communication. In one of the first meta-analyses conducted on a set of Ganzfeld studies, Honorton (1985) reports an overall significant rate of 38% correct guesses (Stouffer's z = 6.6, p = 2,1 x 10^{-11}). Following a series of criticisms and methodological recommendations jointly agreed between Honorton and skeptical researcher Ray Hyman (Hyman & Honorton, 1986), Honorton conducted a second major meta-analysis on a series of autoGanzfeld studies that followed a more strict procedure (Bem & Honorton, 1994) reporting a significant hit rate of 32.2% (Stouffer's z = 3.8, p = 5 x 10^{-5}). Storm and Ertel (2001) also report a significant effect size of 0.138 (Stouffer's z = 5.59, p = 1,14 x 10^{-8}) in a meta-analysis of 79 Ganzfeld studies. However, some researchers have criticised the lack of robust replication of successful results across laboratories and this is, nowadays, the most daunting problem in this area of research (Milton & Wiseman, 1999). Along this line, Bem, Palmer, and Broughton (2001) observed that those studies that adhered to the standard Ganzfeld protocol achieved a significant hit rate of 31% while those other that used nonstandard protocols obtained near-chance results (24%) in the examination of a database of studies up to 1997. In a more recent paper, Storm, Tressoldi, and Di Risio (2010a) report a meta-analysis on three types of study: those that used the standard Ganzfeld technique, studies that used non-Ganzfeld, noise reduction techniques (such as meditation, relaxation, or hypnosis), and other non-Ganzfeld, no noise reduction studies. The authors report that the mean effect size value of the Ganzfeld database (mean ES = 0.14, 95% CI: 0.07, 0.02; Stouffer's z = 5.48, p = 2.13x10-8) was significantly higher than the mean effect size of the non-Ganzfeld no noise reduction (mean ES = -0.029, 95% CI: -0.07, 0.01; Stouffer's z = -2.29, p = 0.98) but not significantly higher than non-Ganzfeld, noise reduction database (mean ES = 0.11, 95% CI: 0.01, 0.21; Stouffer's z = 3.35, p = 2.08x10-4). They also found that studies with selected participants (e. g. those who believed in the paranormal, had regularly practiced a mental discipline, etc.) showed higher hit rates than studies with unselected participants, but only in the Ganzfeld condition. In a reply, Hyman (2010) criticises the methodology of the authors and accuses them of making a largely heterogeneous database appear homogeneous. Hyman remarks that evidence in parapsychology has not reached yet a level of consistency to meet scientific criteria. However, Storm et al. (2010b) followed the standard meta-analytic procedure of finding outliers and trimming the heterogeneous databases of these outliers so that they were homogeneous.

Some authors go further and argue that near-chance or non-significant hit rates in a given experiment do not necessarily imply absence of the phenomenon. In theory, some participants could use ESP unconsciously to underscore, cancelling out any above-chance scoring of the rest of the sample. This has been called *the psi-missing effect* (Carpenter, 1971; Kennedy, 1979, 2001). The literature is filled with studies that report different scoring patterns upon manipulation of experimental conditions, personality traits, or belief. An impressive example would be what has been called *the sheep-goat effect*, by which those participants who believe in the possibility of ESP tend to score significantly above chance expectation while those who feel more sceptical tend to score, also significantly, below. Along this line, Lawrence (1993) reports a meta-analysis of 73 published studies exploring this peculiar effect. Having found a small ($r = .029$) but rather significant effect size (Stouffer's $z = 8.17$, $p = 1.33\text{x}10^{-16}$), Lawrence concludes that the evidence for the sheep-goat effect is clear.

Traditionally, researchers have also explored a large number of personality traits, mood, situational, and interpersonal variables in participants and experimenters in an effort to outline a robust experimental protocol for successful ESP testing. However, the findings have not been clear. In a previous study (Pérez-Navarro, Lawrence, & Hume, 2009a), we explored a wide range of predictors of participants' scores in a Ganzfeld test. However, despite the large number of variables included in our study we were unable to identify a set that predicted our participants' performance robustly across all experimental conditions. Instead, we observed that, curiously, the predictors varied significantly from one condition to another, and concluded that, if ESP exists, it might not be a trait-like individual ability, but could appear, instead, as an interaction of personal, interpersonal, and environmental factors. Thus, different participants may require different experimental environments and different researchers may achieve different results with different participants. The lack of replication of findings in previous research, therefore, could have been due to the heterogeneity of experimental environments and techniques used.

In the present study we do not intend to demonstrate ESP unequivocally but to present a classification method for participants, based on trait and state, to show how weighting sessions is a sophisticated means of predicting performance within a fixed experimental context. For this, we ran three experiments. In the first experiment ($N = 60$), we explored personality traits, mental state factors, and other individual differences that had previously appeared in the literature. We conducted a logistic regression analysis to find out which of these variables predicted best our participants performance in a Ganzfeld ESP test. The second experiment ($N = 90$) was run under similar conditions. We used the equation derived from the first experiment to predict participants' performance in this second series. The value of this practice is that participants could be pre-selected or sessions could be cancelled when the mental and/or emotional states of the participants that predict a hit are not present. In a third confirmatory experiment ($N = 87$) we tested the practical value of this method to find out whether its application would increase the hit rate. Thus, we tested a total of 237 volunteers. In the first experiment we selected traits from the literature that had correlated with the participants' performance in previous studies, like *extraversion* (Honorton & Ferrari, 1989), *openness, agreeableness* and *conscientiousness* (Kanthamani & Rao, 1972); *prior psi-laboratory testing* and *practice of mental disciplines* (Bem & Honorton, 1994); or *artistic pursuit* (e. g. Dalton, 1997). Similarly, some indicators of the participants´ mental state during the period of Ganzfeld stimulation, like *absorption* (Irwin, 1994), *altered state of consciousness* (Stanford, 1979), *sensory adaptation*, *concern about the external environment*

(Palmer, Khamashta, & Israelson, 1979; Stanford & Angelini, 1984) and *expectancy of success* (Taddonio, 1976), have been reported in association to the participants´ ESP scores in previous studies. *Neuroticism* (Braud, 1977) and emotional states like *anger and frustration* (e. g. Schmeidler, 1950, 1954) have been shown to be negatively associated with the experimental outcome (Haraldsson & Houtkooper, 1991). We also included in our design four variables from our two previous studies (Pérez-Navarro, Lawrence, & Hume, 2009a, 2009b). These were *internal awareness, empathy, energetic arousal,* and post-session *confidence of success*.

On the basis of results reported in previous meta-analyses, it was hypothesised that the overall hit rate of the three experiments would be significantly above chance expectation (one-tailed). Due to multiplicity of contrasts alpha levels were kept at .01. In experiment I and II alpha levels were reduced to .005 for correlation analyses conducted between the variables and the participants' scores in the Ganzfeld session. These latter analyses were two-tailed.

Experiment I

Method

Design — The association between the predictor variables and the participants' performance in the ESP Ganzfeld test were explored through correlation and logistic regression. The session outcome (dependent variable) was defined using a nominal scoring method for each participant. The individual simply indicated, on a 'blind' basis, the one of four choices of stimuli that resembled most closely his/her mental imagery and subjective impressions during the period of Ganzfeld stimulation. If the stimulus chosen was the one that the sender participant was trying to communicate, the individual scored a *hit*. If it was not, he/she scored a *miss*.

Participants — Sixty participants were recruited through advertisement of the study amongst the student population around the university campus. The study was advertised as an ESP study, though no further information about the characteristics of the experiment was provided at this stage apart from its estimated duration. Student participants were enrolled in a variety of courses, though most of them were psychology students. A minor number of university staff also took part in the study voluntarily. Approximately half of the participants took part in the study in exchange for research participation points. Individuals were encouraged to come along with a friend or relative so that one could play the role of receiver and the other of sender. There were 14 males and 46 females. The age of the participants ranged from 18 to 57, with a mean of 25.8 and a standard deviation of 4.2.

Measures, Apparatus, and Materials — We used the software *CoolEdit* to create a thirty-minute white noise mp3 track. This was played through a PC, via headphones, to the receiver participant during the session in order to provide a homogeneous auditory environment as described in the Ganzfeld technique. Visual attenuation was achieved by projecting a red lamp on translucent acetate eye covers from approximately 40 cms from the individual's face. We also used a wireless radio transmitter system, a clip-on microphone and a PC in order to feed back the receiver's report to the sender.

Questionnaires: The following questionnaires were used for the assessment of the individual differences and state variables.

The Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992): This is a measure of five major dimensions or domains of personality. The instrument has been shown to be appropriate for both males and females and for all ages. The five domain scales and thirty facet scales allow a comprehensive assessment of

PsychOpen
publishing psychology

adult personality. Form S (self-report), which was used in this study, consists of 240 items answered on a five-point scale. The five domains are as follows: neuroticism, extraversion, openness, agreeableness and conscientiousness. Each domain is composed of six facets. To avoid multiplication of variables and comparison, only the domains were analysed in the present study.

The Self-Consciousness Scale (SCS; Fenigstein, Scheier, & Buss, 1975): This scale consists of twenty-three items, ten measuring private self-consciousness, seven for public self-consciousness plus six social anxiety items. Only internal awareness, from the private self-consciousness subscale, was analysed in this study. Participants were asked to rate themselves from zero *(extremely uncharacteristic)* to four *(extremely characteristic)* on each statement.

UWIST Mood Adjective Checklist (Matthews, Jones, & Chamberlain, 1990): This scale consists of twenty Likert-type items to assess energetic arousal, tense arousal, hedonic tone, and anger/frustration and was used to assess the participants' mood prior and during the Ganzfeld session.

The Impulsiveness, Venturesomeness and Empathy Questionnaire (IVE; Eysenck & Eysenck, 1991): This is a 54-item questionnaire measuring three personality traits: impulsivity, venturesomeness and empathy. The items are self-report and answered as yes or no.

A *pre-session questionnaire* was constructed to assess the participants' prior laboratory research participation experience, practice of mental disciplines, artistic pursuit, and expectancies of success in the experiment.

Similarly, a *post-session questionnaire* was used in order to assess the participants' subjective experience during the sensory attenuation period. This explored absorption, altered state of consciousness, sensory adaptation, feelings of frustration, and concern about the sender during the sensory attenuation.

Target Stimuli: A pool of 32 objects was organised into four sets of four pairs each (4 x 4 x 2). These objects were selected by the experimenter so that they could be interesting and attention-catching for the participants. They consisted, above all, of small toys, souvenirs, Christmas decoration, and some other common utensils like a key ring, a piece of soap, a hat, a small ball, etc. Each pair of objects was placed into a plastic bag, and each set (of four bags) was kept in a small box. Bags were labelled with the set number (a number from 1 to 4) and a letter from a to d for later random selection. The four boxes were labelled each with the set number they contained. A duplicate pool was used for judging in order to avoid sensory leakage from the sender to the receiver participant (Palmer, 1983).

Procedure — A standard Ganzfeld procedure (as described in the introduction) was used in this experiment. When prospective participants approached the experimenter they were asked to fill in the individual differences questionnaires and were then scheduled for a Ganzfeld session that would normally take place within a week. Two experimenters were involved in the study: the first author of this article (experimenter A) and a co-experimenter (experimenter B). At the time of the session, experimenter A accompanied the receiver participant to the laboratory and asked him/her to fill in the pre-session questionnaire. Meanwhile, experimenter B gave the instructions to the sender in a distant room. Experimenter B then opened an envelope containing a randomly generated code for set and target selection, and gave the corresponding stimuli to the sender participant. At the same time, experimenter A, in the laboratory, gave the instructions to the receiver in a standard manner and started the session. In order to feed back the receiver's report to the sender a wireless radio transmitter system was set up at the receiver room. The system received the input from a clip-on microphone through the PC and transmitted it to the sender's headset.

Experimenter A remained in a room next to the receiver's room listening to the individual's report through headphones and writing down his/her comments. In 30 minutes from the commencement of the session experimenter B let experimenter A know the set number (but not the target number a, b, c, or d) that contained the target stimulus via SMS (text message). Experimenter A ignored this until the period of Ganzfeld stimulation was completed. The experimenter then reviewed the individual's report adding any further clarifications and comments from the participant. Then, the participant filled in the post-session questionnaire while experimenter A displayed on a table (in randomised order) a duplicate of the set of objects previously revealed by experimenter B to contain the target pair of objects. The individual was then asked to examine these four choices, named A, B, C and D, and try to indicate which one resembled most closely his/her mental imagery and subjective experience during the Ganzfeld stimulation, ranking the stimuli from 1 to 4. At this time, experimenter A was only aware of the set of stimuli that contained the target pair of objects, but kept blind to which of these choices was the right one. It was a requirement of the protocol, at this point, that the experimenter would not help the individual in his decision in any way. Nobody at all was allowed to enter the laboratory until the participant's response had been registered. Finally, when the judging process had been completed, the experimenter accompanied the participant to the sending room to find out the identity of the targets.

Results

Target selection was tested for equiprobability of target, set number, and order of presentation of the target in the judging sequence. Using an alpha level of .01, the distribution of targets for the 60 sessions proved to be random for the four target alternatives (i. e. A, B, C, D; $\chi^2 = 2.4$, p = .49) and set number (1 to 4; $\chi^2 = 3.32$, p = .34). The position of the target stimulus and decoys in the judging sequence was also random ($\chi^2 = 1.72$, p = .63). This rules out the possibility that participants could have chosen the right stimulus due to position preferences or that more 'attractive' items had been selected as target more frequently.

Twenty of the 60 participants pointed at the target stimulus as the most similar to their spontaneous mental images and subjective experience during the Ganzfeld sensory deprivation, achieving a non-significant hit rate of 33.3% (z = 1.48, p = .07, one tailed). The power of this analysis, for an expected effect size[1] of approximately 0.15 (as suggested from previous meta-analyses), would be 0.08 with an alpha level of 0.01 and the sample size used in this study. The distribution of ranks of the target stimulus, displayed in Table 1, reveals an interesting increasing pattern of scoring by the participants. Sixty-three per cent of the individuals ranked the correct stimulus either first or second (z = 2.06, p = .019, one-tailed), while only 37% did as either of their last two choices. This difference is significant (z = 2.55, p = .005, one tailed). In this case, the power of the analysis was .25.

Table 1

Expected and Observed Frequencies for Each Target Rank.

	Ranks				
	1st	**2nd**	**3rd**	**4th**	**Total**
Expected	15	15	15	15	60
Observed	20	18	14	8	60

Variable *concern about the sender* (.38) during the Ganzfeld correlated significantly with the participants' performance at an alpha level of .005. *Absorption* (-.46) and *altered state of consciousness* (-.39) also showed p-values smaller than .005. A stepwise forward logistic regression analysis was performed on the predictors that showed correlation coefficients with p-values of .05 or less. After four steps, a four variable solution was reached. The form of the equation was as follows[2]:

$$\text{PROB (hit)} = \frac{1}{1+e^{-(-1.12+2.43\,MD-.35\,SA+.90\,SC-1.74\,AB+\varepsilon)}}$$

According to this model, the probability for a right guess {PROB (hit)} is accounted by four variables. In the equation, MD and SC mean "practice of mental disciplines" and "concern about the sender (during the period of Ganzfeld stimulation)" and contributed to the session outcome with a positive coefficient in the equation of 2.43 and .90 respectively. SA and AB mean "sensory adaptation" and "absorption", contributing negatively to the session outcome with coefficients -.35 and –1.74 respectively. ε is the error term.

The equation classified correctly 86.2% of the cases, predicting accurately 89.5% of the hits and 80% of the misses. A test of the model against the constant-only model was statistically significant ($\chi^2_{7.22}$ = 36.9, p < .001), which means that the set of variables predicted reliably the outcome of the session. The model accounted for 34% of the variance as indicated by the Hosmer & Lemeshow's goodness of fit statistic, R_L^2 (.34), an analogue of R^2 in multiple regression.

A χ^2 test run on the remaining variables shows that addition of new variables would not increase the predictive power of the model (χ^2 = 2.3, p = .12). The amount of unexplained information that remains in the model is indicated by a –2 log likelihood statistic (–2LL) of 42.9 (a perfect solution would be associated to a –2LL of 0). The Wald's statistic, used to test the significance of the β coefficient for each predictor, reached statistical significance for all variables included in the equation. The correlation between the observed values and the ones predicted by the equation, another indicator of the accuracy of the model, was also high and significant (r_{xy} = .78, p < .001, one tailed).

Experiment II

Method

Design and Participants — The same experimental design used in experiment I was used for this second series (N = 90). Participants were also recruited through advertisement of the study among the same population four months later. The age range of the participants was from 18 to 62, with a mean of 24.3 and a standard deviation of 5.1. There were 23 males and 67 females.

Measures, Apparatus, and Materials — The set of questionnaires described in experiment I was used, in turn, in this second series. An additional PC was used to display the target stimuli (videoclips, instead of objects) to the sender participants. We used a pool of 16 videoclips of one minute length as target material. These were selected by the experimenter from TV movies, commercials, cartoons, etc. so that they could be appealing and attention-catching for the participants, and organised into four sets of four clips. Videoclips were managed and displayed to the sender participants through the software *SuperLab 4.0*.

Procedure — In experiment II we followed the same procedure as in experiment I, with the only exception that video clips were used, instead of objects, as target stimuli. The randomly selected video clip was played to the sender on a 17” TFT screen six times, once every four minutes from the commencement of the session. In this study we also provided real time feedback of the receiver's report to the sender via radio transmitter. After the 30 minutes of Ganzfeld stimulation, the target video clip was played with three controls to the receiver participant so that he/she could judge the degree of correspondence between his/her mental experience during the sensory attenuation and each videoclip.

Results

The distribution of targets for the 90 sessions proved to be random for the four target alternatives (i. e. A, B, C, D; χ^2 = 4.30, p = .23) and set numbers (1 to 4; χ^2 = 3.06, p = .38). The position of the target stimulus in the judging sequence was also random (χ^2 = 5.51, p = .13).

From the 90 participants who took part in the study, 24 (26.6%) pointed at the correct videoclip as the most similar to their subjective experience during the Ganzfeld stimulation. The difference between this rate of successful guesses and the one expected by chance alone (25%) is not statistically significant (z = .35, p = .36, one tailed).

Only two of the seven variables that were included in the logistic regression analysis in the first experiment were significantly associated with the participants’ performance at α = .005 in this second experiment. These were *sensory adaptation* (-.32) and *absorption* (-.35) during the Ganzfeld stimulation. The other three variables, *neuroticism*, *practice of mental disciplines,* and *altered state of consciousness,* showed correlation indices in the same direction as in the first experiment, though these were not significant (Table 2).

Table 2

Correlation Coefficients and p-Values (< .05) of ESP Predictors in Experiments I and II.

Variable	Experiment I	Experiment II
Neuroticism	-.21 (p = .048)	-.11 (n. s.)
Empathy	-.22 (p = .046)	.01 (n. s.)
Practice of mental disciplines	.26 (p = .040)	.13 (n. s.)
Sensory adaptation	-.32 (p = .012)	-.32* (p = .002)
Concern on the sender	.38* (p = .002)	-.10 (n. s.)
Absorption	-.46* (p = .000)	-.35* (p = .002)
Altered state of consciousness	-.39* (p = .002)	-.25 (p = .018)

Note. *means significant at α = .005.

In order to assess the practical value of the logistic regression equation obtained in experiment I, trials in the second experiment were given a weighting of zero when the logistic regression equation predicted a miss. This increased the rate of correct guesses in experiment II from 26.6% to 36.4%, although significance was still not achieved (z = 1.51, p = .06, one-tailed). The power of this analysis was left at .05 due to the reduction of the sample from 90 to 33 as a consequence of knocking out trials. Twenty-one participants selected the target in the first or second position (z = 1.56, p = .06, one-tailed). The power of the analysis in this case was .13.

Experiment III

Method

Design and Participants — In experiment III (N = 87) we used the same design as in experiment I and II, with the exception that participants were selected. We screened a pool of 316 individuals, selecting 87 who reported having practised a mental discipline (the only pre-session variable in the logistic regression equation derived from experiment I). There were 29 males and 58 females. The age range of the participants was from 18 to 55, with a mean of 22.4 and a standard deviation of 7.9.

Measures, Apparatus, and Materials — In order to select our participants we used an item from the pre-session questionnaire in experiment I that asked the individual whether they had ever practiced a mental discipline such as yoga, meditation, relaxation, biofeedback, etc. on a regular basis. We also used questions from the post-session questionnaire used in experiment I to assess the variables *sensory adaptation, concern about the sender, and absorption* during the Ganzfeld stimulation.

As in experiment I we used a thirty-minute white noise sound track that was played to the receiver participant through a PC and headphones. We also used translucent acetate eye covers and a red lamp approximately 40 cms away from the individual's face. A wireless radio transmitter system together with a clip-on microphone and a PC were also used in order to fed back the receiver's report to the sender participant. The system received the input from a clip-on microphone through the PC and transmitted it to the sender's headset.

Target stimuli: We used a pool of 40 objects selected from previous studies and from the first experiment. We selected colourful, unusual, and attention catching objects. They consisted, above all, of small toys and souvenirs. The 40 objects were randomly organised into 10 sets of 4 and kept in a box labeled with a set number. Each object in every set was also randomly labeled with a letter from a to d for later target selection. A duplicate pool was used for judging in order to avoid sensory leakage from the sender to the receiver participant (Palmer, 1983).

Procedure — In experiment III we followed the same procedure as in experiment I and II, using standard Ganzfeld and objects as target stimuli. We also provided the sender feedback of the receiver report via radio transmitter. Eighty-seven participants were recruited, in first instance, from a population of 316 individuals on the basis of one single variable: having practised a mental discipline. At the end of the Ganzfeld stimulation, these individuals were asked to fill in a post-session questionnaire assessing the other three variables in the equation (i. e. sensory adaptation, absorption, and sender concern). At this stage, their probability of succeeding in the experiment was computed using the logistic regression equation derived from the first experiment. When the scores of a participant predicted a miss, the session was automatically aborted and this participant was never asked to make a guess about the target. Otherwise, the experiment was continued as usual. This intervention left us with 55 participants who completed the experiment.

Results

Randomization tests showed that the 10 different sets were selected in the experiment with the same frequency (χ^2 = 2.91, p = .96). Similarly, each object, within each set, was also selected as target with the same frequency (χ^2 = 2.07, p = .56). The position of the target stimulus in the judging sequence was also random (χ^2 = 2.22, p = .53).

Eighteen participants (32.7%) chose the target stimulus as the most similar to their spontaneous mental images and subjective experience during the Ganzfeld. Although this hit rate was observed in the hypothesised direction, it did not reach statistical significance at a .01 alpha level (z = 1.32, p = .09, one tailed). The power of this analysis, however, was .07 due to the reduction of the sample. Thirty-three participants (60%, z = 1.48, p = .07, one tailed) ranked the correct stimulus either first or second, while only 22 did as either of their last two choices. This difference is not significant either (z = 2.09, p = .02, one tailed). The power of the analysis in this case was .23.

If we pool the data of our three experiments, including experiments I and II with unselected participants, in total, we conducted 205 Ganzfeld trials, where we observed 62 direct hits (30.2%, z = 1.73, p = .041, one tailed) and 122 binary hits where participants ranked the target either first or second (59.5%, z = 2.71, p = .003, one tailed). Applying the logistic regression equation in experiment II discharges 57 sessions, leaving us with exactly 50 direct hits (33.7%, z = 2.44, p = .007) and 92 binary hits (62%, z = 2.92, p = .0017) in 148 trials across the three experiments. The power of these analyses are .18 and .61 respectively.

Discussion

Experiment I produced a non-significant rate of 33% correct guesses. However, a more sensitive analysis revealed that the number of participants that ranked the target stimulus in the first or second position was significantly higher than the number of participants who did in the third or fourth position. Variable *feeling concerned about the sender* during the period of Ganzfeld stimulation was significantly, and positively, associated with the participants' performance. This could reflect an effort by the participants to focus on the relevant source of ESP information. It was surprising to observe that some variables that in theory would be associated with decreased internal noise, like *sensory adaptation, altered state of consciousness,* or *absorption* were negatively associated with the session outcome. This, together with the fact that several individuals reported having fallen asleep or "nearly asleep" during the sensory attenuation, makes us wonder whether the sample of participants was underaroused. This could have been due to characteristics of our testing environment like the lighting, temperature in the laboratory, or the fact that the participants laid back in a comfortable reclining chair during the 30 minutes of sensory attenuation. Those individuals who experienced sensory discomfort, or were more alert, might have kept a level of activation more appropriate to completing the task.

A logistic regression analysis in experiment I produced an equation that predicted the probability of a right guess on the basis of one stable trait (*practice of mental disciplines*) and three mental state indicators (*absorption, sensory adaptation, and concern about the sender*). This does not constitute a robust ´recipe´ for successful replication of ESP across laboratories. In our previous studies we concluded that different experimental contexts, protocols, and even experimenters might require different characteristics of the tested sample and vice versa. However, we used this equation to predict scores in experiments II and III as these were conducted under similar conditions, by the same researchers and on the same population.

Experiment II provided no evidence in support of the ESP hypothesis with a non-significant rate of correct guesses of 26%. When we used the equation derived from experiment I to discharge the trials where a miss was predicted, the hit rate increased from 26% to 36%. Nevertheless, these results were not conclusive due to the reduction of the sample to only 33 participants deteriorated markedly the power of the analysis.

Experiment III was designed to screen a larger sample of participants. The selected sample, after applying the equation from the first experiment as a filter, achieved a non-significant hit rate of 32.7%. This procedure, however,

PsychOpen
publishing psychology

proved useful to achieve a rate of correct guesses comparable to the ones reported in meta-analytic work (32.2% reported by Bem & Honorton, 1994; 31% by Bem, Palmer, & Broughton, 2001; 31.6% by Storm & Ertel, 2001; and 32.2% by Storm, Tressoldi, & Di Risio, 2010a,b). Furthermore, if we pool the data of our three experiments and apply the logistic regression equation in experiment II, we observe encouraging results, with a highly significant percentage of 33.7% correct direct guesses and 62% binary hits.

Nevertheless, it must be acknowledged that a problem of visibility remains in the area. Even if we assume that meta-analysis has proven ESP, the effect size found in the laboratory keeps being small, and this, together with the fact that the field also lacks an integrative theoretical framework where the experimental data can live in consonance with the currently accepted scientific paradigm, is nowadays the main obstacle in the development of this area in terms of financial support, interdisciplinary co-operation, and effective dissemination and acceptance of findings. We wonder whether we are still far from understanding the underlying mechanisms of ESP that would help us to unfold a fully visible version of the phenomenon in the laboratory or, in contrast, we are simply dealing with a very weak effect. Nevertheless, we encourage researchers not to feel constrained by the Ganzfeld protocol and explore more creative ways to show clearer results in the laboratory. The method outlined here is portable and can be used with different experimental contexts, techniques, and populations. Researchers should not assume either that ESP is a trait like ability but take into consideration that the phenomenon might arise as the result of a complex interaction among personal, interpersonal and environmental factors.

Funding

We gratefully acknowledge the financial support of Fundacao Bial, which has enabled us to conduct this study.

Notes

1) We used Cohen's h = arcsine p_1 - arcsine p_2 (Cohen, 1992) in the power analyses reported across the three experiments.
2) The form of the logistic function is

$$f(z) = \frac{1}{1+e^{-z}}$$

where f(z) represents the probability of a particular outcome and z is a measure of the global contribution of all independent variables included in the model.

References

Avant, L. L. (1965). Vision in the Ganzfeld. *Psychological Bulletin, 64*(4), 246-258. doi:10.1037/h0022208

Bem, D. J. (1994, January). "Anomaly or artifact? Comments on Bem and Honorton": Response to Hyman. *Psychological Bulletin, 115*(1), 25-27. doi:10.1037/0033-2909.115.1.25

Bem, D. J., & Honorton, C. (1994, January). Does psi exist? Replicable evidence for an anomalous process of information transfer. *Psychological Bulletin, 115*(1), 4-18. doi:10.1037/0033-2909.115.1.4

Bem, D. J., Palmer, J., & Broughton, R. S. (2001). Updating the Ganzfeld database: A victim of its own success? *The Journal of Parapsychology, 65*(3), 207-218.

Blackmore, S., & Trościanko, T. (1985). Belief in the paranormal: Probability judgements, illusory control, and the `chance baseline' shift. *The British Journal of Psychology, 76*, 459-468. doi:10.1111/j.2044-8295.1985.tb01969.x

Braud, W. G. (1977). Psi conducive conditions: Explorations and interpretations. In B. Shapin & L. Coly (Eds.), *Psi and states of awareness* (pp. 221-237). New York, NY: Parapsychology Foundation.

Carpenter, J. C. (1971, April). The differential effect and hidden target differences consisting of erotic and neutral stimuli. *Journal of the American Society for Psychical Research, 65*, 204-214.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159. doi:10.1037/0033-2909.112.1.155

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI): Professional manual* (Rev. ed.). Odessa, FL: Psychological Assessment Resources.

Dalton, K. (1997). Is there a formula to success in the Ganzfeld? Observations on predictors of psi-Ganzfeld performance. *European Journal of Parapsychology, 13*, 71-82.

Eysenck, H. J., & Eysenck, S. B. G. (1991). *Manual of the Impulsivity, Ventureness, and Empathy Questionnaire*. Kent, UK: Hodder and Stoughton Educational.

Fenigstein, A., Scheier, M. F., & Buss, A. H. (1975, August). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology, 43*(4), 522-527. doi:10.1037/h0076760

Goulding, A. (2004). Schizotypy models in relation to subjective health and paranormal beliefs and experiences. *Personality and Individual Differences, 37*(1), 157-167. doi:10.1016/j.paid.2003.08.008

Haraldsson, E., & Houtkooper, J. M. (1991, April). Psychic experiences in the multinational human values study: Who reports them? *Journal of the American Society for Psychical Research, 85*(2), 145-165.

Honorton, C. (1977). Psi and internal attention states. In B. Wolman (Ed.), *Handbook of parapsychology* (pp. 435-472). Jefferson, NC: McFarland and Company.

Honorton, C. (1978). Psi and internal attention states: Information retrieval in the Ganzfeld. In B. Shapin & L. Coly (Eds.), *Psi and States of Awareness*, (pp. 79-100). New York, NY: Parapsychology Foundation.

Honorton, C. (1985, March). Meta-analysis of psi Ganzfeld research: A response to Hyman. *The Journal of Parapsychology, 49*(1), 51-91.

Honorton, C., & Ferrari, D. C. (1989, December). "Future telling": A meta-analysis of forced-choice precognition experiments, 1935-1987. *The Journal of Parapsychology, 53*(4), 281-308.

Hyman, R. (1985, March). The Ganzfeld psi experiment: A critical appraisal. *The Journal of Parapsychology, 49*(1), 3-49.

Hyman, R. (1994, January). Anomaly or artifact? Comments on Bem and Honorton. *Psychological Bulletin, 115*(1), 19-24. doi:10.1037/0033-2909.115.1.19

Hyman, R. (2010). Meta-analysis that conceals more than it reveals: Comment on Storm et al. (2010). *Psychological Bulletin, 136*(4), 486-490. doi:10.1037/a0019676

Hyman, R., & Honorton, C. (1986, December). A joint communique: The psi Ganzfeld controversy. *The Journal of Parapsychology, 50*, 351-364.

Irwin, H. J. (1994, December). Paranormal belief and proneness to dissociation. *Psychological Reports, 75*(3 Pt 1), 1344-1346. doi:10.2466/pr0.1994.75.3.1344

Kanthamani, B. K., & Rao, K. R. (1972, September). Personality characteristics of ESP subjects: III. Extraversion and ESP. *The Journal of Parapsychology, 36*(3), 198-212.

Kennedy, J. E. (1979). More on methodological issues in free-response psi experiments. *Journal of the American Society for Psychical Research, 73*, 395-401.

Kennedy, J. E. (2001). Why is psi so elusive? A review and proposed model. *The Journal of Parapsychology, 65*, 219-245.

Lawrence, T. (1993). Gathering in the sheep and goats... A meta-analysis of forced-choice sheep-goat ESP studies, 1947-1993. In Parapsychological Association. (Ed.), *Proceedings of presented papers: The Parapsychological Association 36th Annual Convention* (pp. 75-86). Durham, NC: Parapsychological Association.

Matthews, G., Jones, D. M., & Chamberlain, A. G. (1990). Refining the measurement of mood: The UWIST Mood Adjective Checklist. *The British Journal of Psychology, 81*, 17-42. doi:10.1111/j.2044-8295.1990.tb02343.x

Milton, J., & Wiseman, R. (1999, July). Does psi exist? Lack of replication of an anomalous process of information transfer. *Psychological Bulletin, 125*(4), 387-391. doi:10.1037/0033-2909.125.4.387

Milton, J., & Wiseman, R. (2001). Does psi exist? Reply to Storm and Ertel (2001). *Psychological Bulletin, 127*, 434-438. doi:10.1037/0033-2909.127.3.434

Milton, J., & Wiseman, R. (2002). A response to Storm and Ertel (2002). *The Journal of Parapsychology, 62*, 183-185.

Morris, R. L., Cunningham, S., McAlpine, S., & Taylor, R. (1993). Toward replication and extension of autoGanzfeld results. In Parapsychological Association. (Ed.), *Proceedings of presented papers: The Parapsychological Association 36th Annual Convention* (pp. 177-191). Durham, NC: Parapsychological Association.

Morris, R. L., Dalton, K., Delanoy, D., & Watt, C. (1995). Comparison of the sender/no sender condition in the Ganzfeld. In Parapsychological Association. (Ed.), *Proceedings of presented papers: The Parapsychological Association 36th Annual* Convention (pp. 244-259). Durham, NC: Parapsychological Association.

Palmer, J. (1983, April). Sensory contamination of free-response ESP targets: The greasy fingers hypothesis. *Journal of the American Society for Psychical Research, 77*, 101-113.

Palmer, J., Khamashta, K., & Israelson, K. (1979, October). An ESP Ganzfeld experiment with transcendental meditators. *Journal of the American Society for Psychical Research, 73*(4), 333-348.

Parker, A. (2000, January). A review of the Ganzfeld work at Gothenburg University. *Journal of the Society for Psychical Research, 64*(858), 1-15.

Pérez-Navarro, J. M., Lawrence, T., & Hume, I. (2009a). Personality, mental state, and procedure in the experimental replication of ESP: A preliminary study of new variables. *Journal of the Society for Psychical Research, 73*(894), 17-32.

Pérez-Navarro, J. M., Lawrence, T., & Hume, I. (2009b). Personality, mental state, and procedure in the experimental replication of ESP: A logistic regression analysis of a successful experimental condition. *European Journal of Parapsychology, 24*, 37-48.

Russell, D., & Jones, W. H. (1980). When superstition fails: Reactions to disconfirmation of paranormal belief. *Personality and Social Psychology Bulletin, 6*, 83-88. doi:10.1177/014616728061012

Schlitz, M. J., & Honorton, C. (1992, April). Ganzfeld psi performance within an artistically gifted population. *Journal of the American Society for Psychical Research, 86*(2), 83-98.

Schmeidler, G. R. (1950, March). Some relations between picture-frustration ratings and ESP scores. *Journal of Personality, 18*, 331-343. doi:10.1111/j.1467-6494.1950.tb01254.x

Schmeidler, G. R. (1954). Picture-frustration ratings and Esp scores for subjects who showed moderate annoyance at the Esp task. *The Journal of Parapsychology, 18*, 137-152.

Stanford, R. G. (1979, July). The influence of auditory Ganzfeld characteristics upon free-response ESP performance. *Journal of the American Society for Psychical Research, 73*(3), 253-272.

Stanford, R. G., & Angelini, R. F. (1984, June). Effects of noise and the trait of absorption on Ganzfeld ESP performance. *The Journal of Parapsychology, 48*(2), 85-99.

Storm, L., & Ertel, S. (2001). Does psi exist? Comments on Milton and Wiseman's (1999) meta-analysis of Ganzfeld research. *Psychological Bulletin, 127*, 424-433. doi:10.1037/0033-2909.127.3.424

Storm, L., Tressoldi, P. E., & Di Risio, L. (2010a). Meta-analysis of free-response studies, 1992-2008: Assessing the noise reduction model in parapsychology. *Psychological Bulletin, 136*(4), 471-485. doi:10.1037/a0019457

Storm, L., Tressoldi, P. E., & Di Risio, L. (2010b). A meta-analysis with nothing to hide: Reply to Hyman (2010). *Psychological Bulletin, 136*(4), 491-494. doi:10.1037/a0019840

Taddonio, J. L. (1976, June). The relationship of experimenter expectancy to performance on ESP tasks. *The Journal of Parapsychology, 40*(2), 107-114.

Utts, J. (1991). Replication and meta-analysis in parapsychology. *Statistical Science, 6*, 363-378. doi:10.1214/ss/1177011577

Wierzbicki, M. (1985). Reasoning errors and belief in the paranormal. *The Journal of Social Psychology, 125*, 489-494. doi:10.1080/00224545.1985.9713529

Williams, L. M., & Irwin, H. J. (1991). A study of paranormal belief, magical ideation as an index of schizotypy and cognitive style. *Personality and Individual Differences, 12*(12), 1339-1348. doi:10.1016/0191-8869(91)90210-3

About the Authors

José M Pérez-Navarro, PhD, is working as a researcher at the School of Heath in the University of Greenwich, London, UK, where he has previously worked as a Senior Lecturer. His areas of interest are the psychology of exceptional human experiences, paranormal belief, and the scientific evaluation of paranormal claims. He is currently working on the development of an experimental protocol for successful ESP testing. Address for correspondence: Dr. José M Pérez Navarro, Department of Psychology and Counselling, School of Health and Social Care, University of Greenwich, Avery Hill Road, London, SE9 2UG, United Kingdom. Email: josemiguel.navarro@unir.net

Katharine Cox has worked as a Research Assistant at the School of Health in the University of Greenwich. Her areas of interest are paranormal belief and the psychology of exceptional human experiences. Address for correspondence: Katharine Cox, Department of Psychology and Counselling, School of Health and Social Care, University of Greenwich, Avery Hill Road, London, SE9 2UG, United Kingdom. Email: katharinecox@hotmail.com