

A REEXAMINATION OF NONINTENTIONAL PRECOGNITION WITH OPENNESS TO EXPERIENCE, CREATIVITY, PSI BELIEFS, AND LUCK BELIEFS AS PREDICTORS OF SUCCESS

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ABSTRACT: The notion that psi may be able to function without conscious intent and mediate adaptive consequences is a feature of several theories of psi. In particular, Stanford's "Psi-mediated Instrumental Response" (PMIR) model predicts that psi can operate without conscious awareness, facilitating advantageous outcomes by triggering preexisting behaviours in response to opportunities or threats in the environment. Luke and colleagues tested elements of this model over 4 studies involving an implicit, forced-choice precognition task in which participants were positively or negatively rewarded based on their performance in relation to the MCE. The 4 studies combined yielded significant evidence of an implicit precognition effect. The present study attempted to replicate this precognition effect using a more refined contingent reward system employing images from the International Affective Picture System. The number of trials per participant was increased to enhance statistical power, whereas all other design elements remained consistent with the original studies. Fifty participants achieved a tacit precognition hit rate marginally greater than the MCE, but the extent of their outperformance was not significant. Nevertheless, together with Luke and colleagues' 4 studies, the combined effect size remains significant (Stouffer $Z = 3.25$, $p = 0.001$). Findings are interpreted in relation to Stanford's PMIR model.

Keywords: psi, parapsychology, ESP, precognition, creativity, beliefs

There has been a recent growth in interest amongst parapsychological researchers in attempting to capture psi effects experimentally through tacit means. Such interest can partially be accounted for by the notion that psi phenomena such as extrasensory perception may serve advantageous or adaptive functions as has been inferred from numerous "happy ending" anecdotes of spontaneous, everyday instances of purported psi (e.g., Orme, 1974). The majority of these cases do not involve experiencers actively attempting to use any psychic ability, but nevertheless their behaviour is thought to be influenced by factors not obviously available to the conventional sensory systems. Indeed, Broughton (1991) has suggested that, in its naturally occurring state, psi may be an entirely unconscious process and has more recently alluded to an evolutionary explanation of psi

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(Broughton, 2010). In the laboratory, these ideas have been operationalised into experimental methods that attempt to capture the nature of psi by modeling it as a process which occurs outside of conscious awareness, with examples including prestimulus response (Radin, 1997) and precognitive habituation (Bem, 2003).

In this vein, Luke and colleagues (Luke, Delanoy, & Sherwood, 2008; Luke & Morin, 2009; Luke, Roe, & Davison, 2008) conducted a series of four experiments that were designed to test elements of one model that involves the unconscious operation of psi: Stanford's Psi-mediated Instrumental Response (PMIR) model (Stanford, 1974, 1977, 1982, 1990). The PMIR model is multifaceted, but could be summarised as suggesting that psi can operate unconsciously, facilitating advantageous outcomes for the organism by triggering pre-existing behaviours in response to opportunities or threats in the environment. By implication, experimental psi tasks do not necessarily require the conscious intent of the participant, nor even their awareness of the requirement of psi. Indeed, such awareness and intent could potentially be counter-productive. Thus, the computer-based method developed for Luke, Delanoy, and Sherwood's (2008) study, and adapted for subsequent studies, comprised of presenting participants with 10 sets of four fractal images and assigning them a quick-response preference indication task that required them to select which image out of each set they found the most aesthetically pleasing. Unknown to the participants, this constituted an implicit, forced-choice precognition task as, after each time participants registered their preference, the computer program pseudorandomly selected one of the images as a target, with the participant's selection being scored on a hit or miss basis against the computer's selection. Participants were then directed towards a second task, the nature of which was contingent on their performance on the covert psi task. If the participants outperformed the mean chance expectation (MCE), they were allocated to a positive reward condition, whereas if they scored below the MCE, they were given a "negative reward." In each case, the contingent task was intended to be graded in pleasantness according to the level of over- or under-performance against chance. In this original study, participants in the reward condition were able to rate erotic images aligned to their sexual orientation whereas those in the negative reward condition had to take part in a boring number vigilance task. This basic protocol was applied consistently throughout the subsequent studies, with the variations being that for ethical reasons, erotic reward stimuli were subsequently replaced with humorous cartoon images, and in two of the replications participants were randomly allocated to two groups: After finishing the precognition task, one group was asked to complete the contingent reward task, whereas for the other group the experiment ended and they were allowed to leave without taking part in the contingent reward task.

Table 1 shows that three of the four studies found independently significant support for the implicit psi hypothesis that participants would

select more of the target fractal images than would be expected by chance, with only the most recent replication failing to reach statistical significance, despite the mean score being above the MCE. Taken together, the four studies gave a mean psi score of 2.92 ($SD = 1.46$), which is significantly greater than the MCE of 2.50, $t(197) = 4.04$, $p = <.001$, two-tailed, $ES(r) = .28$.

Table 1
Psi Hit Rates, One-sample t Statistics, and Effect Sizes for Individual and Combined Studies Reported by Luke and Colleagues

	<i>N</i>	<i>M</i>	<i>t</i>	<i>p</i> (two-tailed)	Effect size (<i>r</i>)
Study 1 (Luke, Delanoy, & Sherwood, 2008)	100	2.85	2.51	.01	.24
Study 2 (Luke, Roe, & Davison, 2008)	25	3.40	2.60	.02	.47
Study 3 (Luke, Roe, & Davison, 2008)	32	2.90	2.01	.05	.34
Study 4 (Luke & Morin, 2009)	41	2.80	1.19	.24	.12
Combined	198	2.92	4.04	<.001	.28

The studies in which some participants did not take part in the contingent reward task raised some questions over the PMIR model's assumption that psi should be need-serving. Those participants who were allowed to leave after completing the implicit psi task tended to perform slightly better than those who received a contingent positive or negative reward based on the number of hits they achieved (although differences between mean psi scores for the two conditions did not reach statistical significance). It was not clear from these studies whether this demonstrated that no special personal need had to be served in order to manifest a psi mediated response or whether the ability to leave the experiment early was inherently more rewarding than staying to experience the positive contingent outcome task. To clarify this issue, in Study 4 Luke and Morin (2009) asked participants in each group to rate how pleasant they found the experiment overall. Participants in the group for whom the experiment ended after they completed the implicit precognition task rated the experiment as more pleasant than those in the group who took part in the contingent reward task, the difference between their subjective ratings being statistically significant, $t(26) = 3.59$, $p = .001$, two-tailed. The assertion that participants preferred to leave the experiment rather than complete the contingent task was thereby supported. However, the PMIR model's prediction that the tendency towards a psi-mediated response should be

related to the strength of the need which that response serves remains open to question. The use of a larger pool of more sensitively graded stimuli for contingent rewards would allow this relationship to be explored more thoroughly.

Luke and colleagues also considered a number of psychological factors which were thought to be relevant to the propensity of an individual to exhibit a psi mediated effect. In particular, the research gave credence to Broughton's (1991, p. 193) notion that psi may "look like luck": If psi may occur in the unconscious manner specified by the PMIR model, it would be plausible for individuals to attribute such an outcome to being "lucky." Luke's (2007) review of the relationships between perceived personal luckiness and psi performance found a generally positive effect, but this was acknowledged cautiously given the numerous ways in which luck can be conceptualised. Therefore, the studies by Luke and colleagues assessed performance at the implicit psi task in relation to the four nonorthogonal dimensions of the Questionnaire of Beliefs About Luck (Luke, Delanoy, & Sherwood, 2003): Controllable Luck ("luck is primarily controllable, but also internal, stable, and nonrandom"); Chance ("luck is random, unpredictable, unstable, and inert"); Providence ("luck is reliably managed by external higher beings or forces"); and Fortune ("luck is meant as a metaphor for life success rather than as a literal event").

Luke and colleagues had predicted that those who believed luck to be controllable (Controllable Luck) and used the term more literally would be more psi-effective than those who considered luck to be random (Chance) or used the term more metaphorically (Fortune). Table 2 shows that across the four studies, correlations pertaining to each subscale of the QBL and psi scores were inconsistent. The first experiment found a significant correlation between psi task success and the Perceived Personal Luckiness and Luck subscales of the QBL (both $r = .26$), whereas in the second experiment, significant correlations were found between participants' psi score and the Chance ($r = .48$) and Providence ($r = .39$) subscales of the QBL. However, in the third and fourth experiments no relationships between psi score and any of the QBL subscales were identified. Taken together, the results from these four studies paint a suggestive but inconsistent picture of the possible relationship between the way people conceptualise luck or perceive themselves to be lucky and their performance at covert psi tasks. Attempts to replicate these findings would be necessary before any firm conclusions could be drawn in relation to these hypothesised effects.

Of particular relevance to the PMIR model are those psychological factors that may influence the extent to which an individual is sensitive to a psi stimulus, and in turn, their propensity to respond behaviourally in a goal-serving manner. With regard to an individual's psi sensitivity, one concept which would seem especially salient is that of latent inhibition (Lublow, 1989). Latent inhibition relates to the natural tendency of organisms to filter out information that is not deemed relevant to on-going behavioural

operations. If such filtering occurs, then following the argument of Holt, Simmonds-Moore, and Moore (2008) it is conceivable that those exhibiting higher levels of latent inhibition would be more prone to disregard potentially valuable psi stimuli at an early stage. Given the complexity of operationalizing and measuring latent inhibition in the laboratory, Luke and colleagues used Goldberg's measure of openness to experience as an experimental proxy, as previous research had indicated that people who exhibit diminished latent inhibition tend to score significantly higher on the openness to experience subscale of the NEO Five Factor Inventory (Carson & Peterson, 2000; Carson, Peterson, & Smith, 2002; Peterson, Smith, & Carson, 2002).

Table 2
*Pearson Correlations and Two-tailed p Values Comparing Psi Scores
With QBL Subscale and Perceived Personal Luckiness Scores*

	<i>N</i>	QBL subscales					Perceived luckiness
		Luck	Chance	Providence	Fortune		
Study 1 (Luke, Delanoy, & Sherwood, 2008)	100	.26 (.01)	-.16 (.12)	.17 (.09)	.06 (.59)	.26 (.01)	
Study 2 (Luke, Roe, & Davison, 2008)	25	.14 (.51)	.48 (.02)	.39 (.05)	.15 (.48)	.10 (.63)	
Study 3 (Luke, Roe, & Davison, 2008)	32	.12 (.50)	.20 (.27)	-.03 (.86)	-.13 (.48)	—	
Study 4 (Luke & Morin, 2009)	41	-.09 (.56)	.08 (.61)	.23 (.15)	-.08 (.60)	—	
Combined (weighted by sample size)	198	.15 (.03)	.03 (.68)	.18 (.01)	.01 (.90)	.23 (.01)	

— indicates that the measure was not used in the respective study

With regard to the factors that may inhibit a person's tendency to respond to a psi stimulus once it has been detected, Luke and colleagues considered that behavioural or cognitive rigidity may play a key role: Inflexible individuals are likely to be less responsive to new information about imminent events and their subsequent behaviour will consequently have diminished freedom to reflect that information. Holt and Roe (2006; Roe & Holt, 2006) had previously demonstrated an interaction effect between the related concept of lability and performance at a PK task; more labile individuals tended to perform better at the PK task when the target system was more stable, and vice versa. As an operational proxy, the Creative Cognition Inventory (Holt, 2002) was used as a gauge of creativity, a constituent factor of lability. Beliefs in psi and paranormal phenomena were also considered as they have previously been identified as being amongst the most robust correlates of psi task performance (Lawrence, 1993; Palmer, 1971, 1972).

Table 3 presents the Pearson correlations between psi task scores and the factors speculated to influence a person's receptivity and responsivity to psi stimuli. Over the studies reported, Luke and colleagues found belief in psi and paranormal phenomena to be significantly correlated with participants' performance at the tacit psi task. Psi task scores were also found to be moderately correlated with openness to experience in the third study, but this effect was not replicated in the fourth study. No evidence of the predicted effect of creativity was found. Overall, belief factors seemed to be the strongest correlates of performance at the tacit psi task, whereas the role of openness to experience and its assumed link with latent inhibition remained unclear and thus warranted further exploration.

Study 1 also gave Luke and colleagues a chance to consider whether people who believed they could use their psi and/or their luck to influence the outcome of the experiment were able to outperform those who didn't hold such an expectation. Although both psi- and luck-sheep (believers) did outperform the goats (nonbelievers), the differences between their scores were not statistically significant, psi: $t(98) = 1.20, p = .12$, one-tailed; luck: $t(98) = .95, p = .17$, one-tailed.

Considering the findings of the four studies carried out by Luke and colleagues, it is clear that the experimental task developed for this paradigm represents a promising method which has so far seemed relatively consistent in demonstrating assumed extrasensory effects under controlled conditions. However, previous paradigms have suffered from so-called decline effects, whereby significant psi-indicative results diminish over time and are replaced by failed replication attempts (cf. Colborn, 2004). Replication attempts are therefore necessary to evaluate the robustness of this protocol and present opportunities to refine specific aspects of the experimental process which are potentially problematic and shed further light on the seemingly inconsistent individual difference factors hypothesised to influence participants' performance at the tacit psi task.

The current study was therefore designed as a replication of the Luke, Delanoy, and Sherwood (2008) paradigm in an attempt to reproduce the overall psi effect and clarify the relationship between psi task performance and enjoyment of contingent tasks as well as to further explore the role of the previously reported psychological correlates of covert psi task success.

Table 3
Correlations and Two-tailed p Values of Psi Scores With Sheep-Goat, Paranormal Belief, Openness to Experience, and Linear and Nonlinear Creative Cognition Inventory Scores

	<i>N</i>	Sheep-Goat	AEI	OPE	CCI Linear	CCI Non-linear
Study 1 (Luke, Delanoy, & Sherwood, 2008)	100	.24 (.02)	.19 (.05)	—	—	—
Study 2 (Luke, Roe, & Davison, 2008)	25	—	—	—	—	—
Study 3 (Luke, Roe, & Davison, 2008)	32	—	—	.46 (.01)	.25 (.17)	.20 (.27)
Study 4 (Luke & Morin, 2009)	41	.49 (.001)	—	-.08 (.64)	—	—
Combined (weighted by sample size)	198	.31 (<.001)	.19 (.05)	.16 (.19)	.25 (.17)	.20 (.27)

— indicates that the measure was not used in the respective study

In evaluating the efficacy of Luke and colleagues' software-based approach, we identified that there was room for improvement in the clarity of the user interface, as well as specific aspects of the methodology. The protocol was therefore refined in three key areas. Firstly, in order to control for the possibility that the previously reported psi-indicative results were due to an undiscovered software-based artefact, the computer program was completely rewritten in an updated programming language (VB.NET). This also allowed for data collection of individual difference measures to be integrated into the software, thus eliminating the potential for human error in manual data entry, and for the user experience to be improved by means of a smoother and more aesthetically pleasing interface.

Secondly, it was noted that the number of trials each participant is required to complete could be increased in order to yield enhanced statistical power. Trials per session were therefore increased from 10 to 15, which was considered a more optimal trade-off between statistical power and potential declines in participant interest and enjoyment. Finally, it was acknowledged that there would be a greater scope for evaluating the predictions of the PMIR model which pertain to the strength of needs subserved by psi-mediated responses if the stimuli used for reward conditions were more sensitively graded. The current study therefore utilised sets of images constructed from the International Affective Picture System (IAPS; Lang & Greenwald, 1993) which were not only deemed to be more ethically suitable for a general population but also included a rating system of the images' valence and arousal that enabled the development of a more precise and carefully graded measure of reward.

In keeping with the previous studies, the planned hypotheses predicted that performance on the implicit precognition task would exceed the mean chance expectation and would be correlated with belief in psi, belief in paranormal phenomena, openness to experience, creativity, and the four subscales of the QBL. It was also predicted that people who believed they could use their psi and their luck to perform better at the psi task would achieve a greater number of hits than disbelievers.

Method

Participants

Twenty-five male and 25 female participants (mean age = 49.00; *SD* = 17.00) were selected by opportunity sampling from friends, colleagues, associates, students from the University of Northampton, interested members of the public, and members of local spiritualist and religious groups. Participants were invited to take part in a "psychological investigation of possible psychic ability and how it relates to an individual's personality and beliefs" either in person or via a notice board advertisement. No incentives were offered in exchange for participation.

Materials

Demographic Questionnaire. This two-item questionnaire asks about participants' age and gender.

Sheep-Goat Belief Questionnaire. This five-item questionnaire contains four questions corresponding to different aspects of the "sheep-goat" belief in psi variable as specified by Palmer (1973) in addition to a fifth item concerning whether or not participants believed their luck could influence the outcome of the psi task. Each item is scored on a true/false basis, yielding a total sheep-goat belief score which can range from 0 to 4.

Anomalous/Paranormal Belief Subscale of the Anomalous Experience Inventory (AEI). This 12-item subscale contains items such as “I believe that many paranormal occurrences are real” and “I believe that people have energy surrounding their bodies” (Kumar, Pekala, & Gallagher, 1994). Each item is scored on a true/false basis, yielding a total score which can range from 0 to 12. The subscale has a reasonable level of internal reliability ($KR-20 = .77$) and was found to have a moderate level of convergent validity (Gallagher, Kumar, & Pekala, 1994).

Openness to Experience Scale (OE). This 20-item questionnaire addresses an individual’s openness to new experiences (Goldberg, 1999). Participants respond to statements such as “Believe in the importance of art” and “Have a rich vocabulary” by indicating the extent to which each statement is an accurate description of themselves. Each item is rated on 5-point Likert scales from very inaccurate to very accurate, yielding a score which can range from 0 to 80. Coefficient alphas for subscales of openness to experience range from .77 to .86 (Goldberg, 1999), and scores have been found to correlate with scores on the equivalent scale of the NEO personality inventory ($r = .56$; Gow, Whiteman, Pattie, & Deary, 2005).

Creative Cognition Inventory (CCI). This 29-item questionnaire addresses the use of different cognitive styles in the creative process, considering factors such as heightened internal awareness, intuition, and playfulness (Holt, 2002). Questions are categorised according to linear (4 items) and nonlinear (25 items) subscales. The linear scale relates to logical analysis, planning, and careful selection of ideas, and has acceptable internal consistency ($\alpha = .72$). The nonlinear scale relates to paying attention to internal states, playful cognition, ideas arising in states along the dream-wake continuum, and a sense of ideas coming from “something other,” and also has acceptable internal consistency ($\alpha = .92$). Both scales were found to have adequate construct, convergent, and discriminant validity (Holt, 2007). Respondents indicate the extent to which experiences such as “Trusting hunches or instincts” and “Paying attention to visual imagery” are important to their being creative. Items are scored on 5-point Likert scales from “not at all important” to “extremely important,” yielding a total score which can range from 4 to 20 for the linear subscale and 25 to 125 for the nonlinear subscale.

Questionnaire of Beliefs About Luck (QBL). This questionnaire consists of 41 items designed to evaluate individuals’ beliefs about luck according to four orthogonal categories, each of which has a good level of internal reliability (Luke, Delanoy, & Sherwood, 2003). The categories are: Luck (“Luck is primarily controllable, but also internal, stable and nonrandom”; $\alpha = .85$), Chance (“Luck is random, unpredictable, unstable and inert”; $\alpha = .83$), Providence (“Luck is reliably managed by external higher beings or forces”; $\alpha = .90$), and Fortune (“Luck is meant as a metaphor for life success rather than as a literal event”; $\alpha = .82$). Each subscale comprises

10 questions, each rated on 7-point Likert scales from strongly disagree to strongly agree, yielding a score which can range from 10 to 70. The final item is a measure of Perceived Personal Luckiness, scored according to the same scale, resulting in a score which can range from 1 to 7. Luke (2007) found each subscale to have acceptable construct validity.

Postsession Validation Questionnaire. This questionnaire consists of three questions designed to provide an independent check of the experimental manipulation. Participants rated their enjoyment of the initial fractal image preference task and of the contingent reward task, both on 10-point Likert scales, as a validation of the reward manipulation. The remaining question asked participants to briefly describe what they thought the purpose of the initial image preference task was in order to ensure their naivety to its implicit precognitive nature. A screen capture displaying the format and exact wording of these questions is appended.

PMIR Visual Basic Program. This software program was written specifically for the purpose of this experiment by the first author (available from the first author on request). The program was based on the computer-based PMIR protocol developed by Luke, Delanoy, and Sherwood (2008), but represented a complete recoding in an updated programming language (VB.NET), enabling the integration of the questionnaires into the program as well as improvements to the user interface. The program was used to present images from two main sets:

International Affective Picture System (IAPS). This system contains a large set of emotive colour photographs, the contents of which span numerous semantic categories including awe, excitement, contentment, amusement, fear, sadness, disgust, and anger (Lang & Greenwald, 1993). The images have been rated by independent judges for their perceived valence, arousal, and dominance. The complete set was filtered to exclude any potentially offensive material before the 480 most positively valenced remaining images were selected. These images were then sorted into 12 progressively more positive and arousing groups of 40 images according to the product of their mean valence and arousal ratings.

Fractals. A set of 60 fractal images was selected from a larger pool of 72 images which had been randomly generated for the Luke, Delanoy, and Sherwood (2008) study using Fractalus (v4.02, a freeware fractal generation program). Each image had been rated by five independent judges for perceived pleasantness and arousal. Fifteen groups of 4 images were selected from the pool to produce sets such that all of the 4 images within a set were closely matched for pleasantness and arousal according to the homogeneity of their ratings (as per Luke, 2007). This was designed to reduce any potential within-set biases with the aim of making the procedure more psi sensitive. However, as a precautionary note, a reviewer commented that this may, in turn, render the target less psi-discriminable within the set.

Procedure

Participants who expressed an interest in taking part in the study were invited to a psychology laboratory at the University of Northampton. They were welcomed and briefed in a private room, where it was explained that the experiment involved a test of psychic ability, but the implicit, precognitive nature of the task was not disclosed (a copy of the information sheet and consent form used during this period is appended). After being given the opportunity to pose any questions, participants were led to a private cubicle where they were left alone to operate the computer program on a laptop computer. The principal investigator waited in a nearby room and was available to help if participants needed any further assistance.

The program displayed a written introduction before collecting the informed consent of the participant and presenting them with digitised versions of the questionnaire battery. Participants were encouraged to answer all of the questions but were free to omit any items they did not wish to answer. Subsequent to the questionnaires, the program presented some further instructions which invited participants to relax and informed them that they would be told when they needed to use their psychic abilities (see Appendices for screen captures showing the full set of instructions). It then proceeded to guide them through what was described as a “preparatory” image preference indication task: Over 15 trials, fractal images were displayed in sets of four homogenous groups (see Figure 1) in random arrangements, and participants followed the instructions to select which image they most preferred from each group. Unknown to the participants, this constituted a forced choice, implicit precognition task as each time the participant had indicated their preferred image from the set, the computer selected one of the images at random as the target, with participants scoring a point if their selection matched the target image.

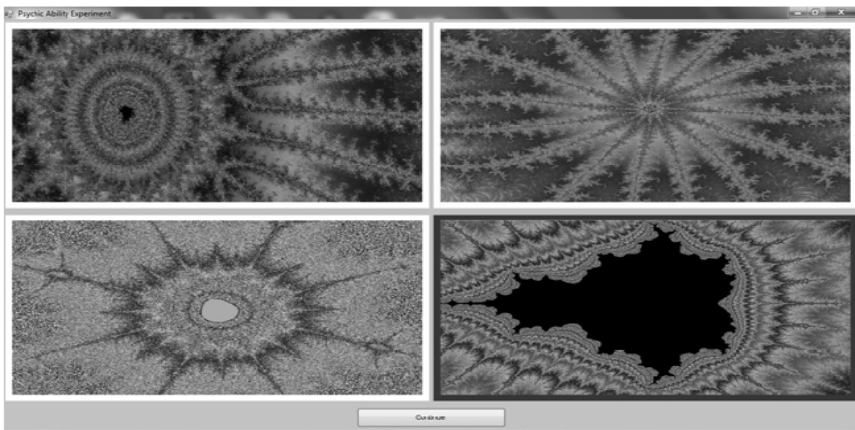


Figure 1. Screen capture of “preparatory” image preference task.

Randomisation of the image array positions and computer target selection was achieved using the random number generation function within VB.NET, which is seeded by the CPU timer. As Radin (1985) has noted that not all pseudorandom number generators produce adequately random data, a 1×4 chi-square analysis was carried out to assess whether there were any biases in the computer's target selection. The test indicated there were no systematic patterns in the computer's selection of the targets, $\chi^2(3, N = 750) = 2.82, p = .42$.

After the 15th trial, the program calculated the participant's score and administered a final task (referred to throughout this report as "the contingent task") contingent upon their performance. Participants who scored above the mean chance expectation (MCE = 3.75) were given a secondary, 10-trial image preference task of the same format (see Figure 2), this time selecting their preferred images from 1 of 12 graded sets of positively valenced pictures from the IAPS set. Participants who scored the maximum number of hits (i.e., 15/15) were shown the most positively valenced and arousing pictures, whereas those who scored minimally above the MCE viewed the least pleasant set of positive images. Conversely, those participants who scored below the MCE at the implicit precognition task were assigned to the negative reward condition and were asked to complete a boring number-vigilance task. Participants in this condition were instructed by the computer to monitor a string of randomly generated single digits which were displayed in 500 ms intervals (see Figure 3) and to press the left mouse button when they noticed a sequence of three consecutive odd (e.g., 1, 9, 3) or three consecutive even (e.g., 8, 4, 8) numbers. The "reward strength" was again graded according to participants' performance at the implicit precognition task: Participants who only marginally underperformed the MCE (i.e., those who scored 3 "hits" out of 15) were required to spend just 2 minutes monitoring the numbers, whereas an extra minute was added to the duration of the task for each additional point of MCE underperformance. No data were collected regarding participants' selections or performance at either contingent reward condition task.

After participants completed the contingent positive or negative reward task, the program informed them that they had completed all of the experimental tasks and then posed the posttask validation questions. The program then requested them to call back the experimenter, who provided a full debrief, including an explanation that the fractal image preference task was, in fact, a covert psi task and that the indication that they would be informed when they needed to use their psychic ability was not upheld. During this time, participants were asked not to discuss the nature of the experiment with other potential participants. Finally, the experimenter answered any remaining questions the participants had before they departed.



Figure 2. Screen capture of positive contingent reward task.



Figure 3. Screen capture of negative contingent reward task.

Ethics

The project was designed to adhere to the British Psychological Society's Code of Ethics and Conduct (BPS, 2009) and received ethical approval from the University of Northampton Research Ethics Committee. Participants were briefed prior to giving their informed consent as part of the program. All data were collected anonymously and participants were made aware of their right to withdraw from the experiment at any time without having to provide a reason.

Results

The hit rates for each participant along with their scores on the individual difference rating scales were recorded. No data were missing from the digital data set, with all participants having answered all of the questions.

In order to check the efficacy of the manipulation of assigning participants to positive and negative contingent reward conditions, the correlations between performance on the implicit precognition task (which, in turn, corresponds to the type and level of contingent reward they received) and participants' postsession evaluation of the pleasantness of the contingent task were assessed. At the end of the experiment, participants indicated how much they enjoyed the contingent task on a scale from 1 to 10 (very unpleasant to very pleasant). Table 4 shows that, as expected, those who partook in the pleasant reward condition generally rated the contingent task as more pleasant than those who completed the negative reward condition (positive condition mean = 7.27, negative condition mean = 3.15), the difference between the ratings being statistically significant, $t(48) = 7.36$, $p < .001$, one-tailed.

Table 4
*Means and Standard Deviation of Participants' Subjective Ratings
of the Pleasantness of the Contingent Task by Task Type*

Reward condition	<i>M</i>	<i>SD</i>
Positive ($N = 30$)	7.27	1.53
Negative ($N = 20$)	3.15	2.43

In order to validate the sensitivity of the ordinally scaled contingent rewards, participants were divided into two groups: those who received a positive reward and those who received a negative reward. Spearman correlations were then calculated between the degree of reward conditions and participants' subjective rating of the pleasantness of the outcome task. For those who received a positive reward, there was a small positive correlation between the image pleasantness category and rating of the contingent reward, but the relationship was not significant, $r_s(29) = .18$, $p = .17$, one-tailed. For those who received a negative reward, there was almost no correlation between the duration of the number vigilance task and rating of the contingent reward, $r_s(19) = -.04$, $p = .43$, one-tailed.

The primary hypothesis predicted a nonintentional precognition effect. Fifty participants each completed 15 tacit precognition trials with an associated probability of correctly selecting the target image of .25. Overall, participants scored a mean hit rate of 4.02 ($SD = 1.67$) whereas they would be expected to score 3.75 ($SD = 1.68$) hits on average by chance alone.

The result of a one-sample t test indicated that, although participants scored more hits than expected by chance, their outperformance was not statistically significant, $t(49) = 1.14$, $p = .13$, one-tailed.

Analyses were also conducted concerning the number of participants who entered the positive reinforcement condition (and hence avoided the negative reinforcement) relative to the number which would be expected by chance. Thirty (60%) of the participants scored an above-chance number of hits in the precognition task and received a positive reinforcement. A binomial calculation revealed that only 53.87% of participants would be expected to receive the positive reinforcement by chance. Nevertheless, a binomial analysis found that the difference between the actual and expected number of participants who received positive reinforcement was not significant, $z = .73$, $p = .23$.

Secondary hypotheses predicted that performance on the implicit precognition task would be correlated with participants' scores on the Luck, Chance, Providence, Fortune, and Perceived Personal Luckiness subscales of the Questionnaire of Beliefs about Luck. Given that the subscales of the QBL are not orthogonal, partial correlations were also calculated to control for variance shared with other subscales. Table 5 illustrates the Pearson and partial coefficients for correlations between these factors. Correlations were found to be small and all failed to reach significance.

Table 5
*Pearson and Partial Correlations of Psi Scores With
QBL Subscale and Perceived Personal Luckiness Scores (N = 50)*

Luck measure	r	p (one-tailed)	r_p	p (one-tailed)
QBL Controllable Luck	.04	.39	.04	.39
QBL Chance	.23	.06	.17	.12
QBL Providence	-.09	.27	-.16	.15
QBL Fortune	.12	.20	.11	.24
Perceived Personal Luckiness	-.20	.08	—	—

— indicates that the measure was not used in the respective study

It was also predicted that performance on the implicit precognition task would be positively correlated with measures of participants' beliefs in psi, beliefs in anomalous/paranormal phenomena, openness to experience, and creativity. For transparency in relation to shared variance and potential confounds, Table 6 presents the matrix of correlations between these predictor variables. Table 7 shows a significant positive Pearson correlation between the psi task score and openness to experience, $r(48) = .29, p = .02$, one-tailed, whereas all other correlations were nonsignificant.

Table 6
Correlation Coefficients and Two-tailed p Values Between Predictors and Psi Scores

	Sheep-Goat	Paranormal Belief	Openness to Experience	CCI Linear	CCI Nonlinear
Sheep-Goat					
Paranormal Belief	.67 ($<.001$)				
Openness to Experience	-.04 (.78)	-.02 (.91)			
CCI Linear	.09 (.53)	.17 (.23)	.21 (.14)		
CCI Nonlinear	.35 (.01)	.55 ($<.001$)	.24 (.09)	.41 (.004)	

Table 7
Correlation Matrix of Predictors of Psi Task Performance: Sheep-Goat, Paranormal Belief, Openness to Experience, and Linear and Nonlinear Creative Cognition Inventory Scores ($N = 50$)

	r	p (one-tailed)
Sheep-Goat	-.03	.42
Paranormal Belief	.02	.45
Openness to Experience	.29	.02*
CCI Linear	.14	.16
CCI Nonlinear	.03	.41

* indicates that the relationship is statistically significant at the 0.05 level

An anonymous reviewer noted that the parametric Pearson correlation test may not be valid for scales with a score range of less than 20 points. This applies to the Sheep-Goat, Anomalous Experience Inventory subscale, and Perceived Personal Luckiness measures. While Pearson correlations are reported above for consistency and comparison with other correlations, Spearman nonparametric correlations were also calculated. The results indicated the same pattern: Sheep-Goat $r_s(49) = -.06$; $p = .35$, Paranormal Belief $r_s(49) = -.02$, $p = .43$; Perceived Personal Luckiness $r_s(49) = -.24$, $p = .05$, all one-tailed.

Finally, it was expected that participants who believed they could use their psi and luck to affect the outcome of the experiment would perform better at the implicit precognition task. Participants responded true or false to the statement "I believe that my psychic ability can affect the outcome of this experiment" and were grouped according to their response. The majority of participants ($n = 37$) indicated that they thought their psychic ability could not influence the outcome of the experiment ("goats") compared with just 13 "sheep." Sheep performed marginally better at the psi task than goats (sheep mean psi score = 4.08; $SD = 1.61$; goat mean psi score = 4.00; $SD = 1.72$), but the difference was not significant, $t(48) = .14$, $p = .44$, one-tailed. The 18 participants (36%) who indicated that they believed their luck could affect the outcome of the experiment scored higher on the psi task than the 32 (64%) who indicated to the contrary (luck sheep mean psi score = 4.61; $SD = 1.46$; luck goat mean psi score = 3.69; $SD = 1.71$). The result of an independent samples t test found the "luck-sheep" performed significantly better than the "luck-goats," $t(48) = 1.93$, $p = .03$, one-tailed.

Post-hoc Analyses

An independent advisor had expressed concern that increasing the number of trials per participant from 10 to 15 may cause a decline effect due to participants becoming less engaged in the task. Post hoc analysis that considered the first 10 and final 5 trials separately was therefore conducted. For the first 10 trials, a total of 138 hits were achieved compared with a MCE of 125 over a total of 500 trials. The result of a one-sample t test, which indicated that participants outperformed chance in the first 10 trials, was suggestive but still nonsignificant, $t(49) = 1.40$, $p = .08$, one-tailed. However, the mean psi score per participant (2.76) and effect size of $ES(r) = .20$ approached that found in Luke's original study (mean hit rate = 2.85, $ES(r) = .24$). For the final 5 trials, a total of 63 hits were achieved compared with a MCE of 62.5 over a total of 250 trials, indicating that participants performed virtually at chance levels in the final 5 trials.

Given this finding, exploratory correlations between psi scores and the aforementioned individual difference measures were recalculated

to include only the first 10 trials. Tables 8 and 9 present the Pearson and partial coefficients for correlations between these factors. The same pattern of results was observed, with only openness to experience correlating significantly with the psi score, $r(48) = .26$, $p = .03$, one-tailed.

Table 8
Pearson and Partial Correlations Between Psi Scores Over the First 10 Trials and QBL Subscale and Perceived Personal Luckiness Scores (N = 50)

Luck measure	<i>r</i>	<i>p</i> (one-tailed)	<i>r_p</i>	<i>p</i> (one-tailed)
QBL Controllable Luck	.15	.16	.13	.19
QBL Chance	.11	.23	.08	.29
QBL Providence	.00	.50	-.12	.21
QBL Fortune	.14	.18	.04	.39
Perceived Personal Luckiness	-.09	.27	—	—

— indicates that this single item measure was not used in partial correlation analysis

Table 9
Correlations of Psi Scores Over the First 10 trials With Sheep-Goat, Paranormal Belief, Openness to Experience, and Linear and Nonlinear Creative Cognition Inventory Scores (N = 50)

	<i>r</i>	<i>p</i> (one-tailed)
Sheep-Goat	-.05	.37
Paranormal Belief	.02	.44
Openness to Experience	.26	.03
CCI Linear	.11	.22
CCI Nonlinear	.08	.30

In response to the aforementioned reviewer's concerns with regard to these data potentially failing to conform to the parametric assumptions underlying Pearson correlation analysis, Spearman correlations were calculated for those scales for which the range of scores is less than 20.

The results indicated the same patterns as those in tables 8 and 9: Sheep-Goat $r_s(49) = -.05, p = .37$; Paranormal Belief $r_s(49) = -.02, p = .44$; Perceived Personal Luckiness $r_s(49) = -.14, p = .16$, all one-tailed.

Gender Analysis

A further suggestion from a reviewer was that the data should be reanalysed by gender in order to assess the extent to which the above findings can be generalised across both genders. Tables 10, 11, and 12 therefore present the summary statistics for psi scores as well as Pearson correlation coefficients between psi scores and the aforementioned individual difference measures by gender for all 15 and the first 10 trials. For these inferential analyses, more conservative two-tailed tests were conducted as no a priori rationale was considered for gender differentials. The result of an independent samples *t* test indicated that although males performed better at the psi task than females (4.24 vs. 3.80), the difference between their scores was not statistically significant, $t(48) = .93, p = .38$, two-tailed. Interestingly, it was found that the significant correlation between psi score and openness to experience reported above seems to have derived primarily from females (all 15 trials $r(24) = .47; p = .02$, first 10 trials $r(24) = .43; p = .03$), whereas for males, the correlations were nonsignificant (all 15 trials, $r(24) = .13; p = .53$, first 10 trials $r(24) = .12; p = .56$). All other correlations remained nonsignificant.

It should be noted that the aforementioned tests, spanning multiple hypotheses, have been conducted without a correction applied to the alpha levels for multiple analyses. Milton and Wiseman (1997) have noted that the standard Bonferroni adjustment should be considered conservative, while Abdi (2007) claims the Bonferroni correction is not appropriate when the inferential tests conducted are not entirely independent. The purpose of these tests was to replicate previously observed relationships. The reader is nonetheless advised to treat the results reported with caution, as the chance of a Type 1 error is increased as a consequence of the multiple analyses carried out.

Table 10
*Means and Standard Deviations of Psi Scores by Gender
for All 15 and First 10 Trials*

Gender	<i>M</i> (15 trials)	<i>SD</i>	<i>M</i> (10 trials)	<i>SD</i>
Male (<i>N</i> = 25)	4.24	1.67	2.88	1.51
Female (<i>N</i> = 25)	3.80	1.68	2.64	1.11

Table 11
Correlations of Psi Scores for All 15 Trials With QBL Subscale, Perceived Personal Luckiness, Sheep-Goat, Paranormal Belief, Openness to Experience, and Linear and Nonlinear Creative Cognition Inventory Scores by Gender

Individual difference measure	Male (<i>N</i> = 25)		Female (<i>N</i> = 25)	
	<i>r</i>	<i>p</i> (two-tailed)	<i>r</i>	<i>p</i> (two-tailed)
QBL Controllable Luck	.04	.84	.01	1.00
QBL Chance	.12	.56	.32	.12
QBL Providence	.04	.87	-.24	.35
QBL Fortune	.09	.66	.11	.60
Perceived Personal Luckiness	-.28	.17	-.14	.49
Sheep-Goat	-.11	.62	.04	.84
Paranormal Belief	-.01	.97	-.02	.93
Openness to Experience	.13	.53	.47	.02*
CCI Linear	.04	.84	.14	.49
CCI Nonlinear	-.14	.50	.11	.61

* indicates that the relationship is statistically significant at the 0.05 level

Table 12
Correlations of Psi Scores for the First 10 Trials with QBL Subscale, Perceived Personal Luckiness, Sheep-Goat, Paranormal Belief, Openness to Experience, and Linear and Nonlinear Creative Cognition Inventory Scores by Gender

Individual difference measure	Male (<i>N</i> = 25)		Female (<i>N</i> = 25)	
	<i>r</i>	<i>p</i> (two-tailed)	<i>r</i>	<i>p</i> (two-tailed)
QBL Controllable Luck	.20	.33	.02	.92
QBL Chance	-.02	.92	.27	.20
QBL Providence	.02	.92	-.04	.84
QBL Fortune	.10	.64	.16	.46
Perceived Personal Luckiness	-.12	.57	-.07	.75
Sheep-Goat	-.10	.62	.01	.98
Paranormal Belief	.02	.93	.02	.92
Openness to Experience	.12	.56	.43	.03*
CCI Linear	.02	.94	.21	.32
CCI Nonlinear	-.13	.52	.23	.28

*indicates that the relationship is statistically significant at the 0.05 level

Discussion

The main purpose of this study was to attempt to replicate and shed further light upon the findings of a series of experiments conducted by Luke and colleagues. The main research hypothesis concerned a test of non-intentional precognition, framed within the context of Stanford's (1990) PMIR model. Participants took part in an image preference activity which, unknown to them, also constituted a forced choice tacit precognition task intended to be unconsciously motivated by a final task whose pleasantness was contingent on their precognitive performance. Overall, participants' performance during the nonintentional precognition task exceeded the mean chance expectation, but the extent of their outperformance did not reach statistical significance. Interestingly, participants' performance on the final five trials (which has been added for the present study) was almost exactly at chance (63 hits compared to an MCE of 62.5). However, when examined in isolation, participants' performance during the first 10 trials also failed to reach statistical significance, albeit with an observed effect size ($ES(r) = .20$) approaching that found in Luke's original study using this paradigm ($ES(r) = .24$).

In considering this finding, two main potential explanations can be offered. Firstly, an independent advisor had suggested that during an extended session of trials, a decline effect may be witnessed as participants may begin to feel bored and less engaged in the task. Alternatively, there may have been systematic qualitative differences in the sets of fractal images used in the first 10 and final 5 trials of the experiment. Although the fractals were displayed in pseudorandom positions within the array for each trial, the set of fractals for each trial remained in the same fixed sequence across all participants. Nonetheless, the sets of fractals for the final 5 trials were compiled from the same original pool of images used to construct the first 10 sets, with the same method being used to minimise the spread of arousal and pleasantness ratings given by independent judges within each set. Crucially, the spread of ratings did not differ significantly for the final 5 trials compared with the first 10. Despite this, it remains possible that the images selected for the first 10 trials possessed certain unidentified characteristics which made them more psi conducive within the PMIR context than those used in the final 5 trials. Choosing between these two possible explanations could be elucidated by randomising the order in which each set is used across the 15 trials and exploring whether the main psi effects tend to derive from specific sets of fractals. Such an approach should be adopted in future studies.

While the most obvious explanation for a participant outperforming the MCE is via his or her choice of fractal image being influenced by extrasensory information, it should be noted that the computer's random target selection was seeded by the computer's clock timer and was thus temporally dependent. An independent reviewer therefore proposed

that rather than foretelling the specific target the computer would select by means of conventional precognition, participants could potentially be integrating anomalously derived information about the computer's target selection system into their decision making strategy. As a result, it would be possible that rather than the extrasensory information altering the participants' choice of fractal image, it may instead have provided an opportunity for participants to "select" a target image as a consequence of exquisite timing of key presses in a manner reminiscent of Decision Augmentation Theory (May, Utts, & Spottiswoode, 1995). Indeed, a psi-mediated increase or decrease in the rate of performing a task, or influence over the time at which a task is initiated, is consistent with the PMIR model and is one of the potential mechanisms proposed by Stanford (1990).

The DAT prediction is not easy to assess within this dataset in a way that would disambiguate it from the conventional precognition explanation. However, we would expect the DAT mechanism to act by exploiting naturally occurring nonrandomness by "selecting" images that participants would naturally have a biased preference for. In such a case, we would expect to find that response biases in participants' selections would be mirrored by the pseudorandom target selections of the computer. To test this, chi square analyses were conducted for each trial to assess whether biases were manifested in either the participants' or the computer's selections of fractal images. The results suggested that during Trial 10, participants had a significant bias towards avoiding fractal image 2, $\chi^2(3, N=50) = 8.08, p = .04$. However, during this trial, the selections of the computer were spread relatively equally across the four potential targets, $\chi^2(3, N=50) = 3.28, p = .35$. Similarly, in Trial 13, participants exhibited a bias towards selecting fractal image 2, $\chi^2(3, N=50) = 12.24, p = .01$. Although this was also the target which the computer selected most frequently, the computer's selection of this fractal did not significantly exceed its selection of the other potential targets, $\chi^2(3, N=50) = 3.28, p = .35$. These findings therefore do not provide any support for the DAT hypothesis. Nevertheless, the fact remains that a statistically significant result was not attained even across the first 10 trials. An important factor that may potentially limit the extent to which PMIR may occur in these experimental situations is the cognitive priming in relation to psi offered to participants during the period leading up to the covert psi task. While every effort was taken to disguise the covert psi task by presenting it as a "preparatory image preference task," and no participants indicated during the postexperiment validation questionnaire that they had discovered (or suspected) the extrasensory nature of the task, they were nonetheless exposed to several references to psi and tests of psychic ability during the recruitment, briefing, and questionnaire phases of the experiment leading up to the tacit psi task. Stanford's specification of the PMIR model indicates that such cognitive priming may interfere with the functioning of psi in both life and laboratory situations. The extent of this interference and its potential threat to the construct validity of this

test is hard to decipher, but it would be worthwhile for future experiments to attempt to find ways to limit the amount of priming that occurs during preparatory stages of experiments testing elements of the PMIR model, while maintaining a sensitivity towards ethical considerations of informed consent. However, if we entertain that extrasensory perception is possible, then there may not exist a method by which a truly covert psi task could be implemented. In the meantime, the extent to which these results might be generalised to life situations in which cognitive primes would presumably be absent should be considered cautiously.

The manipulation of the reward conditions was found to be only partially successful. The contingent task was set such that those participants who performed above the MCE received what was intended to be a positive contingent task, whereas those who scored below the MCE received what was intended to be a negative contingent task. In each case, the positive and negative rewards were graded such that greater over- or under-performance of the MCE yielded a stronger reward in the relevant direction. It was found that there was a relatively strong positive correlation between the number of direct hits participants scored on the psi task and their subsequent subjective assessment of how pleasant they found the contingent task. However, when those participants who received a positive reward and those who received a negative reward were analysed separately, correlations between the degree of the reward and participants' ratings of task pleasantness were not found to be significant. In accounting for this finding, it was thought that the effect could perhaps be "all or nothing" and the avoidance of "punishment" is the main unconscious impetus to perform well at the psi task. In absolute terms, 60% of the participants managed to avoid the negative reward condition, which is consistent with this suggestion but does not deviate significantly from chance expectation.

A secondary goal of the study was to gain a greater understanding of the relationship between psi and beliefs about luck. Researchers such as Broughton (1991) have suggested that need-serving psi-mediated events might be disregarded and instead thought of as lucky coincidences. In this regard, previous experiments had found inconsistent relationships between performance at psi tasks and different subscales of the QBL. This study failed to find significant correlations between participants' psi scores and their individual conceptualisations of luck and their perceived personal luckiness. Given this study's lack of support for the predicted effects and the generally unconvincing experimental evidence concerning the relationship between psi performance and luck beliefs, it is reasonable to suggest that a person's concept of luck in so far as it is measured by the QBL may have no bearing on his or her tacit psi ability. It is worthwhile to note that the QBL is primarily concerned with how luck is conceptualised, rather than whether one is a beneficiary of it. Researchers in future studies may wish to take a different approach to assessing the role of luck beliefs that addresses whether persons believe their luck can serve their needs or goals across a

variety of different situations. In this vein, we found a significant difference between the psi scores of those who believed their luck could affect the outcome of the experiment and those who didn't. It may be, then, that persons' expectations about their prospects of using luck to their advantage are sufficiently psi conducive, irrespective of how they conceptualise the notion of "luck" itself.

Given the inconsistent findings regarding the relationship between psi performance and self-reports about luck concepts and perceived personal luckiness, it may be that more indirect measures could be more informative, especially in relation to the unconscious use of psi. With regard to good luck, Broughton (1988) has suggested that unconscious psi may contribute towards success in life generally. Similarly, an independent commentator noted anecdotally that individuals with low self-esteem or depression seem to be afflicted by a self-fulfilling pessimistic outlook which could conceivably culminate in negative outcomes interpreted as bad luck. Indeed, in proposing the model, Stanford (1990, p. 148) suggested that factors such as neuroticism and poor self-esteem could "dispose towards systematic misuse of PMIR." The relationships between life success, self-esteem, depression, and tacit psi scores may therefore be a fruitful avenue to explore in future research.

With regard to other belief factors, little evidence was found to support the relationships previously identified between participants' performance at a nonintentional psi task and their belief in psi, belief in the paranormal, and belief that their psychic ability could affect the outcome of the experiment. Accounting for these findings is complicated by the nonintentional nature of the psi task. The extent of current knowledge does not allow us to identify where the action of belief in psi and the paranormal may take place, if at all. However, it is worthy of consideration that these beliefs may be active at a subconscious level, and the potential that they may hold a subtle influence over performance at nonintentional psi tasks cannot, in theory, be discounted. Comparing covert and overt versions of the same fundamental psi task may enable a more direct identification of whether sheep and goats perform differentially across psi tasks involving or not involving their conscious awareness and intent.

Finally, this study indirectly considered two individual difference factors that were hypothesised as being potentially inhibitory to the action of psi when considered within the context of the PMIR model. Firstly, it was predicted that individuals exhibiting higher levels of latent inhibition (measured indirectly via Goldberg's openness to experience measure) would perform worse on the implicit precognition task as a result of being more prone to filtering out psi information at an early stage. Secondly, it was hypothesised that more labile individuals (measured indirectly via Holt's Creative Cognition Inventory) would have a higher propensity to respond to psi information within their cognitive system than those with more rigid thought and behaviour patterns, and would therefore achieve

higher scores on the implicit precognition task. The first of these hypotheses was supported, adding further indirect support for the supposition that psi mediated information may be filtered out before it is able to have a tangible effect on behaviour. The use of a more direct measure of latent inhibition in future studies would help to add weight to this notion. When the data were analysed by gender, it was found that the source of this correlation was derived from female participants, whereas the correlation between openness to experience and psi score was nonsignificant for males. This raises a question over the extent to which findings from this study can be generalised across different populations.

No support, however, was found for the hypothesised role of lability, as measured by Holt's (2002) Creative Cognition Inventory. It should be stressed that both measures represented experimental proxies of the underlying dimensions and therefore this evidential basis remains indirect. Empirical support for the relationship between lability and the exhibition of psi phenomena to date is derived primarily from psychokinesis studies that used more direct measures (e.g., Holt & Roe, 2006). The lack of a relationship between lability and psi task performance observed in the present study may be due to the failure of the measure utilised to approximate the underlying concept, or alternatively, it could be that lability is not as relevant to a PMIR scenario in influencing the tendency of an individual to respond to a psi stimulus. Future research should give closer attention to the way in which each factor is operationalised and measured in the laboratory in order to ensure the way the predictors of psi performance are considered is consistent with Stanford's predictions regarding PMIR.

Despite the study's failure to demonstrate an independently significant nonintentional precognition effect, it represents the fifth study to yield results in the predicted direction using this experimental design. Across the five studies of this type carried out to date, the mean, weighted effect size is $ES(r) = .24$. A meta-analysis of the observed hit rates across the five studies yielded a Stouffer $Z = 3.25$, $p = .001$. Furthermore, the authors are not aware of any studies conducted using this paradigm that have produced results in the opposite direction. Taken together, the five studies have demonstrated that this protocol provides a promising means of assessing unconscious psi which warrants further pursuit. While the hypothesised role of beliefs about luck was not upheld, the predicted relationship between success at an implicit psi task and latent inhibition received further indirect support. These findings should serve to direct future studies towards further refinements of the experimental design and a greater focus on developing more direct measures to assess the individual difference factors predicted to hinder the manifestation of unconscious psi.

References

- Abdi, H. (2007). Bonferroni and Sidak corrections for multiple comparisons. In N. J. Salkind (Ed.), *Encyclopedia of measurement and statistics* (pp. 103–107). Thousand Oaks, CA: Sage.
- Bem, D. J. (2003). Precognitive habituation: Replicable evidence for a process of anomalous cognition. *Proceedings of Presented Papers: The Parapsychological Association 46th Annual Convention*, 6–20.
- BPS (2009). *Code of ethics and conduct: Guidance published by the Ethics Committee of the British Psychological Society*. Leicester: British Psychological Society.
- Broughton, R. (1988). If you want to know how it works find out what it's for [Presidential Address]. In D. H. Weiner & R. L. Morris (Eds.), *Research in parapsychology 1987* (pp. 197–202). Metuchen, NJ: Scarecrow Press.
- Broughton, R. (1991). *Parapsychology: The controversial science*. New York: Ballantine.
- Broughton, R. (2010). *An evolutionary approach to anomalous intuition*. Paper presented at the Bial Foundation Convention, Porto, Portugal.
- Carson, S., & Peterson, J. (2000). Latent inhibition and openness to experience in a high-achieving student population. *Personality and Individual Differences*, 28, 323–332.
- Carson, S., Peterson, J., & Smith, K. (2002). Openness and extraversion are related to reduced latent inhibition: Replication and commentary. *Personality and Individual Differences*, 33, 1137–1147.
- Colborn, M. (2004). The decline effect in spontaneous and experimental psychical research. *Journal of the Society for Psychical Research*, 71, 1–21.
- Gallagher, C., Kumar, V. K., & Pekala, R. J. (1994). The Anomalous Experiences Inventory: Reliability and validity. *Journal of Parapsychology*, 58, 402–428.
- Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower facets of several five-factor models. In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7–28). Tilburg, Netherlands: Tilburg University Press.
- Gow, A. J., Whiteman, M. C., Pattie, A., & Deary, I. J. (2005). Goldberg's IPIP Big-Five factor markers: Internal consistency and concurrent validation in Scotland. *Personality and Individual Differences*, 39, 317–329.
- Holt, N. J. (2002). *Creativity and boundary permeability*. Unpublished doctoral study, University of Northampton, Northamptonshire, UK.
- Holt, N. J. (2007). *Creativity, states of consciousness and anomalous cognition: The role of epistemological flexibility in the creative process*. Unpublished doctoral thesis, University of Northampton, Northamptonshire, UK.

- Holt, N. J., & Roe, C. A. (2006). The sender as a PK agent in ESP studies: The effects of agent and target system lability upon performance at a novel PK task. *Journal of Parapsychology*, *70*, 69–90.
- Holt, N. J., Simmonds-Moore, C. A., & Moore, S. L. (2008). Psi, belief in the paranormal, attentional filters and mental health. *Paper presented at the Bial Foundation Convention, Porto, Portugal*.
- Kumar, V. K., Pekala, R. J., & Gallagher, C. (1994). *The Anomalous Experiences Inventory (AEI)*. Unpublished psychological test, West Chester University of Pennsylvania, West Chester, PA.
- Lang, P. J., & Greenwald, M. K. (1993). *International affective picture system standardisation procedure and results for affective judgement*. Technical reports 1A-1C: University of Florida, Centre for Research in Psychophysiology, Gainesville, FL.
- Lawrence, T. R. (1993). Gathering in the sheep and goats ... a meta-analysis of forced-choice sheep-goat ESP studies, 1947–1993. *Proceedings of Presented Papers: The Parapsychological Association 36th Annual Convention*, 75–86.
- Lublow, R. (1989). *Latent inhibition and conditioned attention theory*. Cambridge, England: Cambridge University Press.
- Luke, D. P. (2007). *The parapsychology of luck beliefs, paranormal beliefs and psi*. Unpublished doctoral thesis, University of Northampton, Northamptonshire, UK.
- Luke, D. P., Delanoy, D., & Sherwood, S. J. (2003). *Questionnaire of beliefs about luck*. Unpublished instrument, University of Northampton, Northamptonshire, UK.
- Luke, D. P., Delanoy, D., & Sherwood, S. J. (2008). Psi may look like luck: Perceived luckiness and beliefs about luck in relation to precognition. *Journal of the Society for Psychical Research*, *72*, 193–207.
- Luke, D. P., & Morin, S. (2009). *Luck beliefs, PMIR, psi and the sheep-goat effect: A replication*. Paper presented at the Society for Psychical Research 33rd International Conference, University of Nottingham.
- Luke, D. P., Roe, C., & Davison, J. (2008). Testing for forced-choice precognition using a hidden task: Two replications. *Journal of Parapsychology*, *72*, 133–154.
- May, E. C., Utts, J. M., & Spottiswoode, S. J. P. (1995). Decision augmentation theory: Toward a model of anomalous mental phenomena. *Journal of Parapsychology*, *59*, 195–220.
- Milton, J., & Wiseman, R. (1997). *Guidelines for extrasensory perception research*. Hatfield, UK: University of Hertfordshire Press.
- Orme, J. E. (1974). Precognition and time. *Journal of the Society for Psychical Research*, *47*, 351–365.
- Palmer, J. (1971). Scoring in ESP tests as a function of ESP. Part 1: The sheep-goat effect. *Journal of the American Society for Psychical Research*, *65*, 373–408.

- Palmer, J. (1972). Scoring in ESP tests as a function of ESP. Part 2: Beyond the sheep-goat effect. *Journal of the American Society for Psychical Research*, *66*, 1–26.
- Palmer, J. (1973). ESP scoring as predicted from four definitions of the sheep-goat variable. In W. G. Roll, R. L. Morris, & J. D. Morris (Eds.), *Research in parapsychology 1972* (pp. 37–39). Metuchen, NJ: Scarecrow Press.
- Peterson, J., Smith, K., & Carson, S. (2002). Openness and extraversion are related to reduced latent inhibition: Replication and commentary. *Personality and Individual Differences*, *33*, 1137–1147.
- Radin, D. I. (1985). Pseudorandom number generators in psi research. *Journal of Parapsychology*, *49*, 303–328.
- Radin, D. I. (1997). Unconscious perception of future emotions: An experiment in presentiment. *Journal of Scientific Exploration*, *11*, 163–180.
- Roe, C. A., & Holt, N. J. (2006). The effects of strategy (“willing” versus absorption) and feedback (immediate versus delayed) on PK performance. *Journal of Parapsychology*, *70*, 49–67.
- Stanford, R. G. (1974). An experimentally testable model for spontaneous psi events I: Extrasensory events. *Journal of the American Society for Psychical Research*, *68*, 34–57.
- Stanford, R. G. (1977). Conceptual frameworks of contemporary psi research. In B. B. Wolman (Ed.), *Handbook of parapsychology* (pp. 823–858). London: Van Nostrand Reinhold.
- Stanford, R. G. (1982). An experimentally testable model for spontaneous extrasensory events. In I. Grattan-Guinness (Ed.), *Psychical research: A guide to its history, principles and practices* (pp. 195–205). UK: Aquarian Press.
- Stanford, R. G. (1990). An experimentally testable model for spontaneous psi events: A review of related evidence and concepts from parapsychology and other sciences. In S. Krippner (Ed.), *Advances in Parapsychological Research 6* (pp. 54–167). Jefferson, NC: McFarland.

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Abstracts in Other Languages*Spanish***UN NUEVO EXAMEN DE PRECOGNICIÓN NO INTENCIONAL CON APERTURA A LA EXPERIENCIA, CREATIVIDAD, CREENCIAS EN PSI Y EN LA SUERTE COMO PREDICTORES DE ÉXITO**

RESUMEN: La noción de que psi puede funcionar sin una intención consciente y mediar consecuencias adaptativas es una característica de varias teorías de psi. En particular, la “Respuesta Instrumental Mediada por Psi” (PMIR) de Stanford predice que psi puede operar sin ser consciente, facilitando resultados favorables mediante la activación de conductas preexistentes en respuesta a oportunidades o amenazas en el medio ambiente. Luke y sus colegas evaluaron elementos de este modelo en 4 estudios con una tarea implícita de precognición de elección forzada en la que participantes obtuvieron consecuencias positiva o negativas de acuerdo a su desempeño en relación a la expectativa promedio (MCE). Los 4 estudios combinados produjeron evidencia significativa de un efecto de precognición implícita. Este estudio trató de replicar este efecto de precognición usando un sistema de recompensa contingente más refinado utilizando imágenes del International Affective Picture System. El número de pruebas por participante fue mayor para aumentar el poder estadístico, mientras que todos los otros elementos del diseño se mantuvo consistente con los estudios originales. Cincuenta participantes lograron una tasa de éxito de precognición tácita marginalmente mayor que el MCE, pero el exceso al MCE no fue significativo. Sin embargo, junto con los 4 estudios de Luke y sus colegas, el tamaño del efecto combinado sigue siendo significativo (Stouffer $Z = 3.25$, $p = 0.001$). Interpretamos los resultados en el contexto del modelo PMIR de Stanford.

*French***UN REEXAMEN DE LA PRECOGNITION NON-INTENTIONNELLE AVEC L'OUVERTURE A L'EXPERIENCE, LA CREATIVITE, LES CROYANCES AU PSI, LES CROYANCES A LA CHANCE EN TANT QUE PREDICTEURS DE SUCCES**

Résumé : La notion d'un psi capable de fonctionner sans l'intention consciente et médiatisé par ses conséquences adaptatives est une caractéristique de plusieurs théories du psi. En particulier, le modèle de Stanford de la « Réaction instrumentale médiatisée par le psi » (PMIR) prédit que le psi peut opérer sans attention consciente, facilitant avantageusement les résultats en déclenchant des comportements préexistants en réaction à des opportunités ou des menaces dans l'environnement. Luke et ses

collègues ont testé des éléments de ce modèle dans 4 études impliquant une tâche implicite de précognition à choix forcée dans laquelle les participants étaient sanctionnés positivement ou négativement en fonction de leurs performances par rapport à ce qui est attendu du hasard. Les 4 études combinées montrent des résultats significatifs d'un effet précognitif implicite. La présente étude tente de reproduire cet effet précognitif en utilisant un système de récompense contingente plus raffiné, avec des images de l'International Affective Picture System. Le nombre d'essais par participant fut augmenté pour améliorer le pouvoir statistique, tandis que tous les autres éléments du protocole restaient similaires aux études originales. Cinquante participants ont produit un taux de succès de précognition tacite marginalement meilleur que ce qui était attendu du hasard, mais leur performance n'était pas significative. Néanmoins, combinée avec les quatre études de Luke et ses collègues, la taille d'effet reste significative (Z de Stouffer, $Z = 3.25$, $p = 0.001$). Ces résultats sont interprétés en relation au modèle PMIR de Stanford.

German

EINE ÜBERPRÜFUNG UNABSICHTLICHER PRÄKOGNITION IM ZUSAMMENHANG MIT OFFENHEIT FÜR ERFABUNG; KREATIVITÄT, GLAUBEN AN PSI UND GLAUBEN AN GLÜCK ALS PRÄDIKTOREN FÜR ERFOLG

Die Vorstellung, daß Psi ohne bewußte Absicht funktionieren und dabei helfen kann, sich an daraus ergebende Konsequenzen anzupassen, ist ein vorherrschendes Merkmal verschiedener Psi-Theorien. Besonders Stanfords Modell der "Psi-mediated Instrumental Response" (PMIR) sagt voraus, daß Psi ohne bewußte Aufmerksamkeit operieren kann, indem vorteilhafte Ergebnisse durch bereits existierende Verhaltensweisen herbeigeführt werden als Reaktion auf in der Umgebung vorhandene Gelegenheiten oder Gefährdungen. Luke und Mitarbeiter testeten Elemente dieses Modells anhand von 4 Studien; diese verwendeten eine implizite Präkognitionsaufgabe mit vorher festgelegten Wahlalternativen, bei der Teilnehmer positiv oder negativ belohnt wurden, je nachdem, wie sie in Bezug auf die Mittlere Zufallserwartung (MZW) abschnitten. Zusammengefaßt ergaben die 4 Studien einen signifikanten Hinweis auf einen impliziten Präkognitionseffekt. Die vorliegende Studie versuchte, diesen Präkognitionseffekt zu replizieren, indem ein verfeinertes kontingentes Belohnungssystem verwendet wurde, das auf Bilder aus dem International Affective Picture System zurückgriff. Die Anzahl der Versuchsdurchgänge pro Teilnehmer wurde erhöht, um die statistische Aussagekraft zu erhöhen, während alle übrigen Elemente des Versuchsdesigns mit den vorigen Studien übereinstimmten. 50 Teilnehmer erreichten eine implizite Präkognitionstrefferquote, die etwas über der MZE lag, aber ihre

Gesamtleistung war nicht signifikant. Zusammen mit den 4 Studien von Luke et al. blieb die Gesamteffektstärke jedoch signifikant (Stouffer $Z = 3.25$, $p = 0.001$). Die Ergebnisse werden im Licht von Stanfords PMIR-Modell interpretiert.

APPENDIX A

Participant Information Sheet



Thank you for your interest in our research.

The following study is a psychological investigation of possible psychic ability and how it relates to an individual's personality and beliefs. To explore this, we have designed a computer program which consists of three parts. The nature of what you will be asked to do varies but you will certainly be asked to rate some images and you may have to monitor some numbers. Full instructions will be given throughout the program.

Before you begin the main part of the experiment, you will be asked to complete a battery of questionnaires concerning your personality and beliefs. There are no right or wrong answers to these questions and whilst they may relate to rare or unusual experiences, none of them should be considered abnormal.

After the questionnaire, there will be a preparation task to gauge your preferences. During the task you will be presented with sets of four fractal images. These are mathematic patterns which can produce some beautiful images and you will simply be asked to select the one that you like the most. There will be a few rounds of this task, but this is just a preparation task so you should whizz through them as fast as you can.

Once you've completed all of the rounds, there will be some further instructions given to you by the computer about the final task. As the nature of the task varies with each participant, at this stage I can't tell you exactly what it will be, only that it will be a simple task.

You are asked to follow the instructions and complete all of the tasks as well as you can, and the computer will inform you when you have finished. At this point, you will be asked to call back the experimenter who will discuss a few short questions and then you will be free to leave. The whole process should take 15-20 minutes depending on the nature of the final task.

You are under no obligation to take part in the experiment and can withdraw at any time without having to provide a reason. Furthermore, you may withdraw your data at any time without explanation. The computer program will give you a unique participation code which you can write in the space below. If for any

reason you would like to withdraw your data, please email the experimenter using the contact details provided using the code as a reference.

Please feel free to ask the experimenter any questions you may have and if you are willing to take part, complete the informed consent form before you begin.

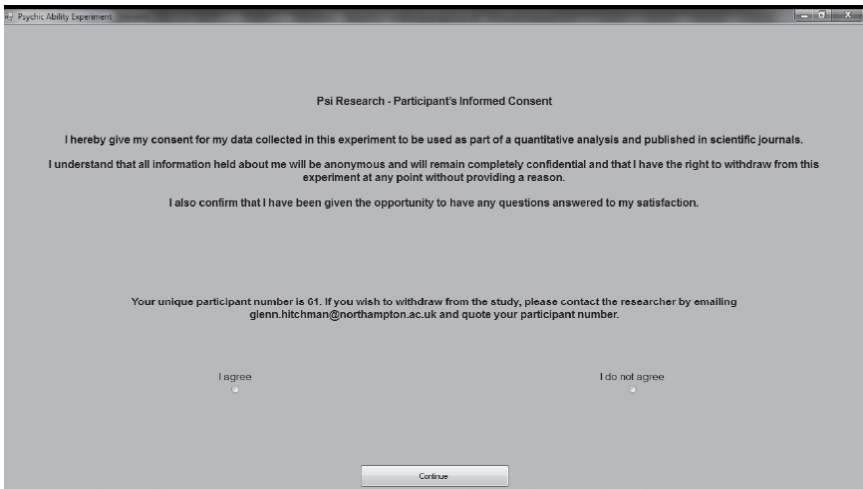
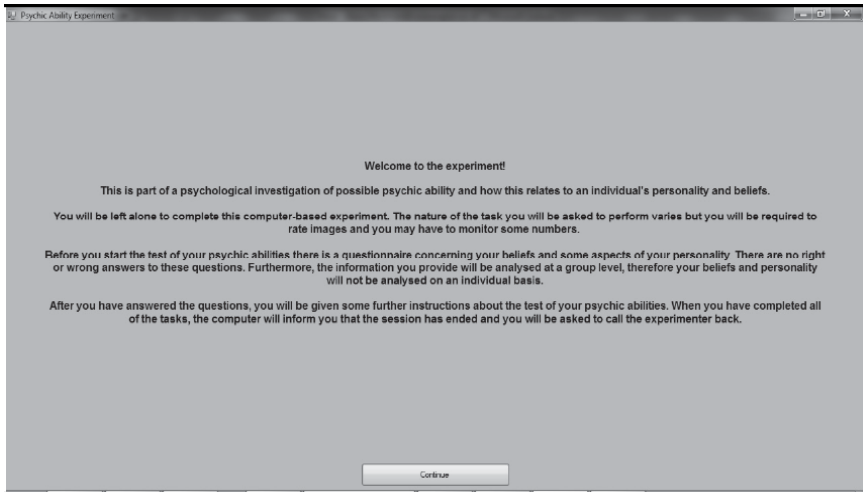
Thanks again for your interest.

Glenn Hitchman (glenn.hitchman@northampton.ac.uk)

Participant ID:

APPENDIX B

Screen Captures of Welcome and Informed Consent Screens



APPENDIX C

Screen Captures of Instructions for Covert Psi Task



APPENDIX D

Screen Capture of Postexperiment Validation Questionnaire

Psychic Ability Experiment

Well done! You have now finished the main part of the experiment.
Finally, please indicate below how much you enjoyed these tasks.

How pleasant did you find the initial preference task with the fractal images?

1 2 3 4 5 6 7 8 9 10
extremely extremely
unpleasant pleasant

What do you think the aim of the first part of the experiment (the fractals) was?

Finally, how pleasant did you find the second task of monitoring the numbers?

1 2 3 4 5 6 7 8 9 10
extremely extremely
unpleasant pleasant

Continue

Note. In cases where participants experienced the positive reward condition, the final question referred to the rating of pleasant images rather than the monitoring of numbers.

