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Precognitive Habituation:

Replicable Evidence for a Process of

Anomalous Cognition

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Abstract

Precognitive Habituation (PH) is a phenomenon that has emerged from a search for a straightforward laboratory demonstration of psi that could: (a) be observed using participants from the general population; (b) be conducted with no instrumentation beyond a desktop computer; (c) be evaluated by simple statistical tests; and, (d) be replicated by any competent experimenter—including a skeptical one.

The PH procedure is based on a well established psychological phenomenon known as the Mere Exposure Effect: Across a wide range of contexts, the more frequently humans or other animals are exposed to a particular stimulus, the more they come to like it.

The PH procedure tests for precognition by, in effect, running a Mere Exposure study backwards. Instead of exposing a participant to repeated exposures of a stimulus and then assessing his or her liking for it, the PH procedure reverses the sequence: On each trial, the participant is first shown a pair of photographs on a computer screen and asked to indicate which picture he or she prefers. The computer then randomly selects one of the two pictures to serve as the "habituation target" and displays it subliminally several times. If the participant prefers the picture subsequently designated as the target, the trial is defined as a "hit." Accordingly, the hit rate expected by chance is 50%.

The PH hypothesis is that the repeated exposures of the target can reach back in time to diminish the arousal it would otherwise produce, thereby rendering negatively arousing targets less negative and positively arousing targets less positive. Because the two pictures in each pair are matched for valence and arousal, participants are predicted to prefer the target-to-be on trials with negatively arousing pictures but the non-target on trials with positively arousing pictures (erotic pictures). Preferences on trials with non-arousing ("low-affect") pictures were not expected to differ from chance.

To date, more than 400 men and women have participated in 9 variations of the PH experiment, including an independent replication by a skeptical investigator. Collectively the studies provide strong support for the two predicted effects. Across the six basic studies, the hit rate was significantly above 50% on negative trials (52.6%, $t(259) = 3.17$, $p = .0008$) and significantly below 50% on erotic trials (48.0%, $t(149) = -1.88$, $p = .031$).

When targets were exposed supraliminally, the PH effect was replicated on negative targets but not on erotic ones. Supraliminal exposures also made the experiment more aversive and triggered conscious cognitive processing.

When the number of target exposures on each trial increased beyond 8, participants significantly preferred the non-target picture on the low-affect trials. This serendipitous finding appears to reflect "precognitive boredom." Like a too frequent TV commercial, the repeated exposures (precognitively) render the target boring, or even aversive, and hence less attractive than its matched non-target. Individuals scoring above the median on either Absorption or Openness to Experience appear most likely to show the precognitive boredom effect.

Precognitive Habituation:
Replicable Evidence for a Process of Anomalous Cognition

The holy grail for many psi researchers has long been a straightforward, transparent laboratory demonstration of psi that could be replicated by any competent experimenter—including a skeptical one—using participants drawn from the general population. Discovering such a replicable psi effect and developing a protocol for demonstrating it was the primary goal of the research program described in this article. As a further inducement to replication, I sought to develop a procedure that would require no instrumentation beyond a desktop computer, would take no more than 30 minutes to complete, and could be analyzed with statistics no more complex than a *t* test across subjects or a binomial test across binary choices. The result of this effort is the Precognitive Habituation (PH) effect.

Many psi researchers have advocated the use of physiological or implicit response measures on the grounds that psi probably operates at an unconscious level, and researchers in cognitive and social psychology have recently developed several implicit measures of cognitive and affective functioning that can be adapted for exploring psi. The Precognitive Habituation procedure uses an indirect measure of psi performance that derives from a well-established phenomenon known as the Mere Exposure (ME) Effect.

The Mere Exposure Effect

Across a wide range of contexts, the more frequently humans or other animals are exposed to a particular stimulus, the more they come to like it. This robust psychological phenomenon has been known for over a century, but it was the 1968 publication of Zajonc's monograph, "Attitudinal Effects of Mere Exposure," that spurred its intensive empirical investigation. By 1987, more than 200 experimental studies of the effect had been published.

The ME effect is very general. For example, after rats were exposed to musical selections by either Mozart or Schönberg, they showed a preference for new selections by the composer with whom they had become familiar. When tones of two different frequencies were played to two sets of fertile chicken eggs, the hatched chicks preferred the tones they had heard prenatally (Rajecki, 1974).

In human studies, individuals exposed differing numbers of times to irregular polygons, nonsense words, Chinese ideographs, photographs of faces, or real people came to like better those to which they had been exposed more frequently; that is, liking was a positively increasing function of exposure frequency. A meta-analysis of 208 such studies by Bornstein (1989) yielded a combined effect size (*r*) of .26, with a combined *z* of 20.80 ($p < .0000001$). This same meta-analysis revealed that the ME effect is stronger when the stimuli are exposed subliminally, that is, at such short exposure times that they cannot be identified. This is interpreted as showing that the ME effect works at an unconscious level and that conscious cognitive processes actually interfere with the primitive affective process presumably responsible for the effect.

The ME effect was first employed as a vehicle for testing psi by Moulton (2000). Using a procedure designed to test for telepathy between a sender and receiver, Moulton showed the sender 10 irregular polygons with the instruction to try transmitting them to the remote receiver who was undergoing ganzfeld stimulation, a form of reduced sensory input. After the 30-minute sending period, the receiver was shown ten pairs of polygons in which one polygon of each pair

was one that had been seen by the sender. The receiver was asked to indicate which of the two polygons he or she liked better. As predicted, receivers significantly preferred the polygons seen by the sender.

The ME effect is typically tested and observed with stimuli that are initially affectively neutral (e.g. polygons, nonsense words). This is also reflected in theorizing about the effect. For example, Zajonc himself (2001) has proposed that the effect reflects a form of classical conditioning that occurs when a novel stimulus is encountered repeatedly in the absence of aversive consequences; it is that absence which plays the role of the unconditioned stimulus.

For my own precognitive studies, however, I wanted to use stimuli that are strongly arousing, reasoning that repeated exposure to such stimuli would produce affective habituation: Negatively arousing stimuli would subsequently be experienced less negatively and positively arousing stimuli would be experienced less positively. Curiously, there were no ME studies that had used high valenced or highly arousing stimuli. A recent non-ME study however—reported after my own studies were in progress—has now confirmed this reasoning. Participants subliminally exposed to extremely positive and extremely negative words subsequently rate those words as less extreme than words to which they had not been exposed: Negative words are rated less negatively and positive words are rated less positively (Dijksterhuis & Smith, 2002).

The Precognitive Habituation Procedure

The Precognitive Habituation procedure tests for precognition by, in effect, running a Mere Exposure study backwards. Instead of exposing a participant to repeated exposures of a stimulus and then assessing his or her liking for it, the PH procedure reverses the sequence: On each trial, the participant is first shown a pair of photographs on a computer screen and asked to indicate which picture he or she prefers. The computer then randomly selects one of the two pictures to serve as the "habituation target" and displays it subliminally several times. If the participant prefers the picture subsequently designated as the target, the trial is defined as a "hit." Accordingly, the hit rate expected by chance is 50%.

The Precognitive Habituation hypothesis is that the repeated exposures of the target can reach back in time to diminish the arousal it would otherwise produce, thereby rendering negatively arousing targets less negative and positively arousing targets less positive. Because the two pictures in each pair are matched for valence and arousal, participants are predicted to prefer the target-to-be on trials with negatively arousing pictures but the non-target on trials with positively arousing pictures (erotic pictures). Preferences on trials with non-arousing ("low-affect") pictures were not expected to differ from chance.

These studies complement the "presentiment" studies reported by Bierman and Radin (Bierman & Radin, 1997; Radin, 1997). In their studies, participants show an anticipatory electrodermal response just prior to the presentation of negatively arousing or erotic pictures but not prior to the presentation of neutral or low arousing pictures. If we interpret the presentiment effect as the precognitive elicitation of arousal, we can analogously interpret the PH effect as the precognitive extinction of arousal. One advantage of the PH procedure is that it makes opposite predictions for the two kinds of stimuli, whereas the presentiment procedure does not.

This article reports eight PH experiments done in my psi laboratory at Cornell University and one external replication by a skeptical investigator. Additional external replications are currently in progress.

Method

Overall Experimental Procedure

During the course of this project, several variations of the experiment were explored. The separate studies differed primarily in the exact instructions given the participant, the number of trials of different types (negative, erotic, and low-affect or "control" trials), the number of exposures of the target, and the specific pictures used. Except where noted, all the experiments used the following general procedure.

> Upon entering the laboratory, the participant was told:
>
> In this experiment, we are interested in measuring emotional reactions to a wide variety of visual images in a procedure that tests for ESP (Extrasensory Perception). The experiment is run completely by a computer and takes about 20–25 minutes.
>
> Each trial of the experiment involves a pair of pictures. First you will be shown the two pictures side by side and asked to indicate which one you like better. You will then be asked to watch passively as those pictures are flashed rapidly on the screen. The way in which this procedure tests for ESP will be explained at the end of the session.
>
> Most of the pictures range from very pleasant to mildly unpleasant, but in order to investigate a wide range of emotional content, some of the pictures contain very unpleasant images (e.g., snakes and bodily injuries), and some contain nonviolent but explicit sexual content (e.g., couples engaged in explicit sexual activity).

The participant then signed a consent form which repeated the warning about the nature of the stimuli. Next, the experimenter seated the participant in front of the computer and withdrew from the cubicle. The cubicle was dimly lit by a floor lamp positioned so that there were no reflections on the computer screen. Overhead fluorescent lights were turned off.

The computer program then proceeded to administer the procedure as outlined above, displaying a pair of pictures on each trial, recording the participant's preference, and then subliminally displaying the randomly selected target several times. At the end of the session, the computer displayed the percent of hits achieved on the different types of trials, and the experimenter interpreted this feedback as part of the post-experiment explanation of the study.

Experimental Materials

The pictures used in the studies were selected from the International Affective Picture System (IAPS; Lang & Greenwald, 1993), a set of 820 digitized photographs that have been rated on 9-point scales for valence and arousal by both male and female raters. For the PH studies, the pictures were divided into six categories defined by crossing 3 levels of valence (negative, neutral, positive) with 2 levels of arousal (low, high). The negative pictures were drawn from the negative/high arousal category. Although some of the erotic pictures were drawn from the positive/high arousal category, the erotic pictures in the IAPS are quite mild. Accordingly, we supplemented them with more graphic erotic pictures downloaded from the Internet. The remaining pictures were drawn from the other categories of pictures and are henceforth referred to as the low-affect pictures. The pictures in each pair were matched for valence and arousal using the ratings supplied with the IAPS set; they were also matched for

content. As the experimental program proceeded, we were increasingly able to match the pictures within pairs for their popularity as well.

In most of the PH studies, the targets were exposed subliminally. To qualify as subliminal, a stimulus must normally be flashed with an exposure time of approximately 4 milliseconds. This is not easily achieved on a computer screen, however, because the screen itself is refreshed much more slowly (1/60 second or about 17 ms on slower monitors). Unless the exposure is synchronized with the screen refresh—a difficult programming task—it may not appear on the screen at all.

There are two common strategies for overcoming this problem: Backward masking and parafoveal exposure. In backward masking, a masking stimulus is flashed immediately after the image appears, effectively "erasing" the image from the retina. In parafoveal exposure, the participant focuses on a spot in the center of the screen while the images are presented randomly on either the left or the right side of the screen (and, hence, to the side of the fovea). Using both these procedures, we were able to expose the images for 17 ms without the participant's being able to identify them more than occasionally.

It should be noted, however, that the validity of the PH effect as a psi phenomenon is not jeopardized by the possibility that participants might be able to identify the target because the computer does not select it until after the participant makes the preference judgment. In fact, experimental Series 300, reported below, used clearly identifiable exposures of 500 ms duration.

Randomization

For the studies described in this article, the pseudo random number generator (PRNG) contained within the programming language (True BASIC) was used to select the picture pair for each trial, the left/right placement of the two pictures, the picture to be the target, and the left/right placement of each subliminal exposure.

Such PRNG's are not very good, however, and they fail many of the mathematical tests used to assess the randomness of a sequence of numbers (L'Ecuyer, 2001). Fortunately, most PRNG's do an adequate job of producing equal frequencies of 0's and 1's for binary decisions of the kind required by the PH protocol. Moreover, it is easy to inspect the data themselves to check these frequencies—and we did: In all the studies reported in this article, neither the selection of the target pictures nor their left/right placements on the screen departed significantly from chance.

A more subtle possibility is that a flawed PRNG might produce recurring patterns within a run of numbers. This could create corresponding patterns in the left/right placement of the target that might coincide with a participant's pre-existing biases (e.g., excessive alternations of left/right placement). This problem is avoided in the PH procedure because successive decisions of the same kind are not made by successive calls to the PRNG. For example, between successive selections of a target or picture placement, the PRNG is called upon to select the picture pair for the trial. Because it does this by repeatedly generating random numbers until an unused pair is located, the number of intervening calls to the PRNG varies from trial to trial, thereby destroying any systematic patterns that might be generated by the PRNG itself.

Nevertheless, we have now replaced the internal PRNG with an algorithm proposed by PRNG expert George Marsaglia in a post to the mailing list *sci.stat.math* on September 29, 1997. The algorithm passes Marsaglia's own famous "Die-Hard Battery" of tests for randomness,

considered to be the most rigorous suite of tests currently available. Most known PRNG's and even many genuine hardware-based RNG's fail one or more of the Die-Hard tests.

Response Measures and Individual Difference Variables

The major dependent variable of a PH study is the percent of times a participant selects the habituation target for each type of trial. The program also records trial-by-trial data, including the identity of the target, its left/right placement, the left/right position of the participant's preferred picture, and his or her response time.

We also explored several individual difference variables, both to learn more about the PH effect by discovering its psychological correlates and, more pragmatically, to develop a screening test that could be used to select potentially successful participants.

All potential participants filled out a questionnaire in their classes at the beginning of the academic semester or filled it out online from their home computers. Any participant who arrived at the laboratory without having taken the questionnaire filled it out at the beginning of the session on the computer that administered the experiment.

The questionnaire assessed variables found in previous research to predict psi performance: Belief in ESP, prior ESP experiences, and practice in meditation or other disciplines requiring an internal focus of attention. Because the experiment involved affective responses to negatively arousing pictures, all potential participants also rated themselves on the following two questions: "In general, how intense are your emotional reactions to movies, videos, or photographs that are violent, scary, or gruesome?" and "In general, to what degree are you aware of, attuned to, or in touch with your emotional reactions to images that are violent, scary, or gruesome?" Responses could range from 1, "*Not at all Intense[Aware],*" to 5, "*Very Intense[Aware]*." For purposes of analysis, anybody who scored above the midpoint on both scales was defined as "Emotionally Reactive"; all others were defined as "Emotionally Nonreactive." Other individual difference measures explored in the course of the program are discussed below.

Security Checks

One goal of the research program was a procedure that could overcome the major obstacle to replication in psi: experimenter effects. For this reason, the role of the experimenter is deliberately minimized in the PH procedure, and it is specifically hoped that the effect will turn out to be relatively independent of the investigator's attitudes toward psi. At the least, it is hoped that even skeptics will be able to satisfy themselves that the protocol is free of artifacts.

To this end, the integrity of the computer program can be checked by running a test session with the masking stimulus turned off. This permits the investigator to see the target on every trial, to record the data by hand, and to compare the handwritten record with the program output. Additionally, an investigator can run a series of control runs by entering a systematic or random pattern of responses. This should produce no psi effects.

The computer in Cornell's psi laboratory is networked to both my home and office computers. As soon as a session was completed, the output file was uploaded to my personal computers, thus preventing any tampering with the output by participants or experimenters. For purposes of external replication, the primary data are recorded in the output file in both plain and

encrypted form, thereby providing security against anyone's altering the data prior to sending me the raw output files.

Participants and Experimenters

Virtually all the participants were volunteers recruited from psychology courses at Cornell University. They either received $5 or credit in their courses for participating. Although we explicitly informed them that they were participating in a study of ESP, there is nothing in the experimental protocol that requires participants to know this. It can simply be presented as a "picture preference test designed to explore unconscious visual processes."

The experimental sessions were conducted by 12 different undergraduate research assistants. This was a deliberate strategy and not just a matter of convenience. As mentioned above, the goal was to design a protocol that could be successfully replicated by a variety of experimenters, not just veteran psi researchers with pro-psi beliefs and "golden hands." Secondarily, it seemed likely that undergraduate participants might be more comfortable viewing erotic materials if the experimenters were their peers.

Experimental Series 100

The first experimental series consisted of three experiments. The first, Experiment 101, was designed to see if the PH procedure would yield a significant psi effect on any kind of target. Accordingly, the 6 kinds of picture pairs composed by crossing 3 levels of valence (negative, neutral, positive) with 2 levels of arousal (low, high) were equally represented across the 48 trials of the session, 8 of each kind. (No erotic pictures were included in this study.) On each trial, there were 4 subliminal presentations of the target at 1-second intervals. The number of participants was preset at 50; 34 female and 16 male Cornell students participated.

Results

The results were clear cut: Only the negative/high arousal pictures produced a significant psi effect, with an overall hit rate of 55.2% ($t(49) = 2.41$, $p = .010$, two-tailed). This was also significantly higher than the chance hit rate observed on the 5 other valence/arousal categories (49.8%, $t_{diff}(49) = 2.28$, $p = .027$, two-tailed). After the fact, then, this experiment can be conceptualized as comprising 8 negative trials and 40 low-affect ("control") trials.

These results are consistent with those from the "presentiment" studies, cited above, in which participants show an anticipatory electrodermal response just prior to the presentation of negatively arousing pictures from the IAPS set but not prior to neutral pictures (Bierman & Radin, 1997; Radin, 1997). The finding also makes sense from an evolutionary perspective because the ability to anticipate danger would be distinctively advantageous for survival.

The absence of a PH effect on the low-affect pictures is not necessarily inconsistent with the fact that the Mere Exposure effect routinely occurs with neutral, non-arousing stimuli. Bornstein's meta-analysis (1989) reveals that ME effects occur only when there is a time interval of at least several minutes between the exposures and the preference judgments. In the PH procedure, the two events occur together within the same trial and are separated by only a few seconds.

Experiments 102 ($n = 60$) and 103 ($n = 50$) were designed both to replicate Experiment 101 and to try out variations in stimulus pairs, instructions to participants, and experimental

procedures. Each session in Experiment 102 comprised 60 trials: 15 negative and 45 low-affect trials. Experiment 103 was the first to include erotic pictures; each session comprised 16 negative, 16 erotic, and 16 low-affect trials. Different erotic pictures were used for men and women under the assumption that men would require more graphically explicit pictures than the women. Also in Experiment 103, the number of subliminal target exposures was increased from 4 to 6.

Collectively, the three studies included 107 women and 53 men. As predicted, the hit rate for negative trials was significantly above 50% (53.0%, $t(159) = 2.86$, $p = .002$, one-tailed), and the hit rate for erotic trials was significantly below 50% (47.1%, $t(49) = -1.88$, $p = .033$, one-tailed). The hit rate on low-affect trials did not differ from chance (50.3%, $t(159) = 0.42$, *ns*).

Sex Differences and Individual Differences

There were strong sex differences in the first three studies. In fact, the psi effects were due entirely to the women: Their hit rate for negative trials was 53.8% , $t(106) = 3.23$, $p = .0008$, one-tailed, and their hit rate for erotic trials was 45.9% $t(34) = -2.20$, $p = .017$, one-tailed. The hit rates for the men were at chance level for both negative trials (51.4%, $t(52) = 0.65$, *ns*) and erotic trials (50.0%, $t(14) = 0.00$, *ns*).

Because the psi literature does not reveal any systematic sex differences in psi ability, this finding is probably due to the fact that the men were less aroused by both the negative and erotic pictures than the women. The ratings supplied with the IAPS pictures reveal that male raters rated every one of the negative pictures in the set as less negative and less arousing than did female raters. Also, a recent fMRI study using IAPS pictures found that men had significantly fewer brain regions than women where activation correlated with concurrent ratings of their emotional experience (Canli, Desmond, Zhao, & Gabrieli, 2002).

The clinching argument for this interpretation, however, comes from our Emotional Reactivity measure. Of the 53 men who participated in Series 100, 16 were defined as Emotionally Reactive by our 2-item scale. Despite their small numbers, this subsample of male participants achieved significant psi performance on the negative trials (59.2%, $t(15) = 2.78$, $p = .007$, one-tailed). Table 1 displays the hit rates on the negative trials as a function of Emotional Reactivity and sex. As can be seen, only emotionally reactive participants achieve a significant psi effect on the negative trials. The Table also shows that a higher proportion of women than men are classified as emotionally reactive.

Table 1

Series 100: Hit Rates on Negative Trials as a Function of Emotional Reactivity and Sex (Chance Expectation is 50%)

	Emotionally Reactive			Emotionally Nonreactive		
Trial Type	**Women** (n = 62)	**Men** (n = 16)	**Combined** (n = 78)	**Women** (n = 42)	**Men** (n = 33)	**Combined** (n = 75)
Negative	**55.1****	**59.2***	**55.9*****	**51.6**	**50.0**	**50.9**
Low Affect	**50.4**	**51.0**	**50.6**	**49.1**	**52.4**	**50.6**

Note. Emotional Reactivity scores were not available for 3 women and 4 men. Significance levels are one-tailed and are based on one-sample *t* tests across subjects.
*$p < .01$. ** $p < .001$. ***$p < .0001$.

Experimental Series 200

Series 200 (Experiments 201, 202, and 203) was undertaken to see if we could strengthen the PH effect—especially for male participants. First, we continued to increase the number of target exposures per trial, to 8 in Experiments 201 and 202, and then to 10 in Experiment 203.

Second, we rematched pictures on the basis of the preference data obtained in Series 100 to better equate the preference choices between the two pictures within each pair. In a few cases, new pictures from the IAPS set were substituted. In Experiments 202 and 203, we introduced different sets of negative pictures for men and women, selecting more gruesome pictures for the men in an attempt to elicit more arousal. Two additional sets of erotic pictures were also added so that men could choose the option of seeing male-male erotic pictures and women could choose the option of seeing female-female erotic pictures.

Third, we constructed an Erotic Reactivity scale to parallel the Emotional Reactivity scale by adapting two relevant items from the Sensation Seeking Scale (Zuckerman, 1974): "I enjoy watching many of the erotic scenes in movies," and "I prefer to date people who are physically exciting rather than people who share my values." Participants who endorsed both statements were defined as Erotically Reactive; all others were defined as Erotically Nonreactive.

Finally, we attempted to increase the proportion of men who participated. Because fewer men than women enroll in psychology courses, this required active recruitment and selection. The number of participants for the entire series was preset at 100; 52 women and 48 men participated. Unfortunately, however, only 6 of the men turned out to be emotionally reactive.

Results

Table 2a shows that the patterns found for the negative trials in Series 100 were successfully replicated in Series 200. Table 2b shows that Erotic Reactivity successfully predicts psi performance on erotic trials in the same way that Emotional Reactivity predicts performance on negative trials.

Table 2a

Series 200: Hit Rates on Negative Trials as a Function of Emotional Reactivity and Sex (Chance Expectation is 50%)

	Emotionally Reactive			Emotionally Nonreactive		
Trial Type	**Women** (n = 32)	**Men** (n = 6)	**Combined** (n = 38)	**Women** (n = 20)	**Men** (n = 42)	**Combined** (n = 62)
Negative	**54.3***	**58.8***	**55.0***	**45.5**	**52.1**	**50.0**
Low Affect	**47.9**	**49.4**	**48.1**	**51.3**	**47.4**	**48.7**

Note. Significance levels are one-tailed and are based on one-sample t tests across subjects.
*$p < .05$.

Table 2b

Series 200: Hit Rates on Erotic Trials as a Function of Erotic Reactivity and Sex (Chance Expectation is 50%)

	Erotically Reactive			Erotically Nonreactive		
Trial Type	**Women** (n = 16)	**Men** (n = 16)	**Combined** (n = 32)	**Women** (n = 36)	**Men** (n = 32)	**Combined** (n = 68)
Erotic	**40.8%****	**44.8***	**42.8*****	**50.9**	**51.5**	**51.2**
Low Affect	**52.9**	**45.5**	**49.6**	**47.6**	**48.1**	**47.8**

Note. Significance levels are one-tailed and are based on one-sample t tests across subjects.
*$p < .05$. **$p < .005$. *** $p < .001$.

In sum, both of the predicted PH effects appear to be real and replicable. Across all six studies of Series 100 and 200, the hit rate is significantly above 50% on negative trials (52.6%, $t(259) = 3.17$, $p = .0008$) and significantly below 50% on erotic trials (48.0%, $t(149) = -1.88$, $p = .031$). Low-affect trials do not differ from chance. These results also imply that researchers seeking to replicate the PH effect can save time and effort by screening out nonreactive individuals ahead of time.

Series 300: Supraliminal Exposures

As noted in the introduction, the Mere Exposure Effect is strongest when the stimuli are presented subliminally, implying that the effect operates at an unconscious level. This is why I decided to use subliminal exposures for the PH procedure. Series 300 was designed to see if supraliminal exposures would also produce the PH effects.

Series 300 included 62 participants in 2 experiments using supraliminal exposures (500 ms at interstimulus intervals of 500 ms), where the number of exposures was either 12 or 15. The results affirmed the original wisdom of using subliminal exposures. First, there was no psi effect on the erotic trials, even for erotically reactive participants. More importantly, however, supraliminal exposures produced two unanticipated consequences.

First, because supraliminal exposures provide explicit trial-by-trial feedback, it changed the nature of the task. Participants became involved in anticipating which picture would appear; for some, it even became an explicit "ESP" challenge to guess the target. In short, supraliminal exposures triggered conscious cognitive processing, undermining the very rationale for using an implicit response measure of psi in the first place.

Second, supraliminal exposures made the experiment much more aversive, especially for the emotionally reactive women. The research assistants began to pick up clues that some of the women were closing or averting their eyes when the more gruesome negative pictures were being flashed. This showed up in the data as a reversal of the relationship of psi performance to Emotional Reactivity: emotionally reactive women now scored at chance level on the negative trials (49.3%, $t(19) = -0.28$, *ns*), but emotionally nonreactive women showed a strong PH effect, 56.3%, $t(17) = 2.52$, $p = .022$, two-tailed. The difference between them approaches significance ($t_{diff}(36) = 1.90$, $p = .07$, two-tailed).

At this point, I asked a skeptical colleague at Williams College, Professor Kenneth Savitsky, to try replicating the PH effect using supraliminal exposures. But I made two critical changes: First, the on-screen directions explicitly instructed the participant to "keep your eyes on the picture as it is flashed—even if it is one of the unpleasant pictures." Second, participants were given the option of participating in the study without the negative pictures. (There were no erotic trials in the Williams replication.)

Savitsky conducted the experiment as a class exercise in a laboratory course in experimental social psychology. Serving as the experimenter, he ran himself and the 17 students in the experiment; each student was then instructed to run 4 of his or her friends. This produced a total of 87 participants, 84 of whom experienced the negative trials. Collectively they obtained a hit rate of 52.5% ($t(83) = 1.57$, $p = .061$) on the negative trials. More importantly, the positive correlation between hit rate and Emotional Reactivity was restored: The 32 emotionally reactive participants obtained a hit rate of 56.0%, $t(31) = 2.66$, $p = .006$. In particular, the 12 emotionally reactive men in the sample achieved a very high hit rate of 59.7%, $t(11) = 3.02$, $p = .006$. The hit rate on the low-affect trials was at chance.

In sum, supraliminal exposures do not eliminate the PH effect for negative pictures, but they do appear to eliminate it for erotic pictures. They also convert the experimental task into a conscious guessing game and make the experiment much more aversive. For these reasons, I urge future investigators to use subliminal exposures. Finally, it is worth noting that the Williams study constitutes the first replication attempt of the PH effect by a skeptical experimenter.

Precognitive Boredom: A Serendipitous Finding

Before our research program had begun, 8 psi researchers visiting the Institute of Noetic Sciences in Petaluma, California tried out an early version of the PH protocol. Collectively, they showed the predicted patterns: 53% hit rate on negative trials and 47% on erotic trials. The striking finding, however, was that they scored so far below 50% on the low-affect trials (37.5%) that they actually achieved a significant *z* score of -2.55 ($p = .01$, two-tailed). We joked about it—"maybe it was the beer"—but did not take it seriously. It now appears, however, that the finding was not a fluke.

As noted above, our first study used only 4 subliminal exposures on each trial. In an attempt to strengthen the PH effect, we kept increasing the number of exposures, moving from 4 to 6, 8, 10, 12, and 15 across the successive experiments. The hit rate on the low-affect trials remained essentially at chance until we reached 10 exposures in Experiment 203, at which point the hit rate on these trials dropped to 46.8% ($t(39) = -2.12$, $p = .04$, two-tailed).

This effect can be interpreted as precognitive boredom. Like a too frequent TV commercial, the many repeated exposures (precognitively) render the target picture boring, or even aversive, and hence less attractive than its matched non-target. This is also consistent with the meta-analytic finding that the Mere Exposure effect with neutral, low-affect stimuli itself levels off after about 8–10 exposures (Bornstein, 1989).

Because this was an unanticipated finding, we looked to see if any of the individual difference measures we were exploring in Series 200 might correlate with it. We discovered that participants who scored above the median on Absorption, the tendency to become deeply absorbed in tasks and sensory experiences (Tellegen & Atkinson, 1974), obtained a hit rate on low-affect trials of 46.8%, $t(52) = -2.22$, $p = .03$, two-tailed, whereas the rest of the sample scored at chance level.

Because this correlate emerged from a fishing expedition among our individual difference measures, we sought to replicate it conceptually in Series 300, the supraliminal series described above. In place of Absorption, we substituted Openness to Experience, which is significantly correlated with Absorption (Church, 1994) but has the advantage of being one of the standard "Big 5" personality variables. Moreover, it has been shown to correlate with reported psi experiences (Zingrone, Alvarado, & Dalton, 1998-1999). The precognitive boredom effect was successfully replicated: Those who scored above the median on Openness to Experience obtained a hit rate on the low-affect trials of 47.0%, $t(47) = -2.87$, $p = .006$, two-tailed, significantly lower than those below the median, who scored at chance level (52.1%, $t_{diff}(92) = -2.75$, $p = .007$, two-tailed).

The precognitive boredom effect is probably the same phenomenon as the PH effect with erotic stimuli in which the repeatedly exposed target loses its erotic appeal and hence becomes boring relative to its matched non-target. The effect on low-affect trials simply has a higher boredom threshold—i.e., needs more exposures before it is observed—than it has on erotic trials. In fact, the measure of Erotic Reactivity that predicts psi performance on the erotic trials in Series 200 also predicts psi performance on the low-affect trials in Series 300: Those above the midpoint on the 5-point scale item "I enjoy watching many of the erotic scenes in movies" score significantly lower on the low-affect trials than other participants: (44.4% vs 51.8%, $t_{diff}(82) = -2.75$, $p = .005$, two-tailed), which is also significantly below chance, $t(36) = -3.35$, $p =$

.002, two-tailed. Although this particular item is not itself on the Openness to Experience scale, conceptually it would seem to be an exemplar of that construct.

If the precognitive boredom effect on low-affect trials turns out to be robust, then investigators might prefer to replicate the PH effect without the use of erotic materials.

Future Studies

If the PH effect continues to replicate with different investigators and subject samples, then several interesting conceptual questions would be worth exploring.

Mere Exposure. As noted in the introduction, there are no Mere Exposure experiments that use strongly affective stimuli. Would a Mere Exposure experiment using the PH procedure and stimulus materials (in other words, a PH study run "forward") show the same two complementary effects that we obtain precognitively?

A second question that arises from the Mere Exposure literature is the question of timing. As noted above, the Mere Exposure effect typically emerges only if there is an interval of time between the exposures and the preference ratings. In the PH protocol, they both occur within each trial and there is no delay between them. One intriguing possibility is that the erotic or low-affect pictures—which become less preferred immediately—might reverse and become more preferred after a period of delay, that is, would show the Mere Exposure effect.

Genuine Randomness. A pseudo random number generator (PRNG) produces numbers that are random only in the sense that they satisfy (or should satisfy) mathematical tests of randomness. The sequence of numbers, however, is produced by a mathematical algorithm and, hence, is completely determined once the initial seed is designated. (The seed is usually based on the system clock, such as the number of milliseconds since the computer was turned on.) In principle, the future state of the system is completely specifiable from knowledge of its present state. In contrast, a genuine random generator is based on a random physical process, such as radioactive decay or diode noise, which is indeterminate in the quantum mechanical sense: the future cannot be inferred from knowledge of the present.

The conceptual advantage of using a PRNG in PH studies is that, barring artifacts, it virtually ensures that we are seeing precognition rather than psychokinesis, that participants are anticipating rather than influencing the target selection. But from a physics standpoint, it would be important to know whether the PH effect can occur when the target cannot be predicted even in principle.

* * *

If the holy grail is a straightforward laboratory demonstration of psi that can be replicated by any competent experimenter, then the PH protocol appears to be a promising candidate for achieving that elusive goal.

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