Emotion and Intuition I, II, III, IV & V
Unravelling variables contributing to the presentiment effect.

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Abstract

The physiological behaviour of subjects to whom a visual stimulus is presented is dependent on the emotional content of the stimulus. The anticipation preceding the stimulus is also reflected in the physiology. Even when stimuli are adequately randomised it turns out that the anticipatory response (also called 'presponse') to emotional pictures is larger than the same response for calm pictures.

In 5 studies this so-called presentiment effect is investigated as a function of a number of variables. The exposure time and the type of the stimuli are manipulated. The ratio between extreme and calm stimuli is another independent variable. The knowledge of the subject concerning the goal of the study is manipulated. Furthermore the presentiment effect is explored while the subject's attention is focused on a categorisation task superimposed on the pictures. Finally the relation between cognitive non-conscious factors and the presentiment factor in intuition is explored.

The results of the first study are reported and these confirm the earlier findings by Radin. The presponse preceding calm pictures is significantly smaller than the one preceding extreme pictures using a pre specified dependent variable (Man Whitney U: $z = 2.7$, $p < 0.007$). Suggestive evidence is found for the prediction that this effect would be strongest for short exposures. Explorations reveal presponse patterns that seem to be typical for specific categories of stimuli like violent or pornographic. A possible normal explanation hitherto not reported is proposed and discussed in the light of the current results and the unfolding University of Amsterdam presentiment research program.

1. Introduction

The idea that psi correlations manifest themselves primarily at a non-conscious level has been popular throughout the history of Parapsychology. Under the assumption that non conscious processes may be measurable by monitoring the physiology of a subject two experiments have been reported that tried to explore physiological indicators of precognitive information. In an elegant experiment in the early seventies John Hartwell, then at Utrecht University, measured the Contingent Negative Variation (CNV) after a warning signal and before a random selected picture of a face was to be displayed (Hartwell, 1978). The CNV is a brain potential that has been associated with anticipatory processes; more precisely the CNV is interpreted as a readiness for response preparation. Therefore the subjects in Hartwell's studies were asked to respond with one of two buttons depending on the gender of the face on the picture.

The warning stimulus was sometimes informative, i.e., the subject could infer from the warning stimulus what the gender type of the face on the picture would be. In those trials a mean CNV was observed that clearly differed for the two stimuli categories. In the other case the warning stimulus was uninformative but it was hoped that the CNV still would indicate what type of picture was about to be shown. Such a finding would suggest that in some way or another the subject had non conscious knowledge of the nearby future.

The results of this experiment were, given the large efforts invested, disappointing. The possible reasons for this failure will be discussed in the concluding section.

Nearly 20 years elapsed before the idea of precognitive information reflected in the physiology of subjects was picked up again by Dean Radin (Radin, 1996). He used the physiological measures Skin Conductance, Heart Rate and Plethismography that reflect sympathetic and parasympathetic behaviour of

our nervous system. Furthermore, in contrast to Hartwell, he used highly emotional pictures that were presented 5 seconds after the subjects had pressed the button for the next trial. In 3 independent studies he found significant differences in physiology, most notably in the skin conductance, preceding the exposure of either calm or extreme pictures. He discusses a number of possible normal explanations but concludes that these do not apply.

However one potential normal explanation, namely the effect of anticipatory strategies, was not discussed by Radin. Subjects who participate in this type of experiment and are aware that once every so often an extreme picture will be displayed may build up (generally incorrect) expectations about the probability that such an extreme picture will be shown in the forthcoming exposure. Indeed, due to the gambler's fallacy, their expectation may increase after each calm picture and may decrease after an extreme. If this expectation is reflected in the amplitude of the anticipatory physiology it will be clear that the largest amplitude in the sequence is always the one preceding the extreme picture (see figure 1, the anticipation preceding 'extreme' is the largest) because after that extreme is presented the subject relaxes and assumes falsely that the probability for another extreme picture has become smaller.

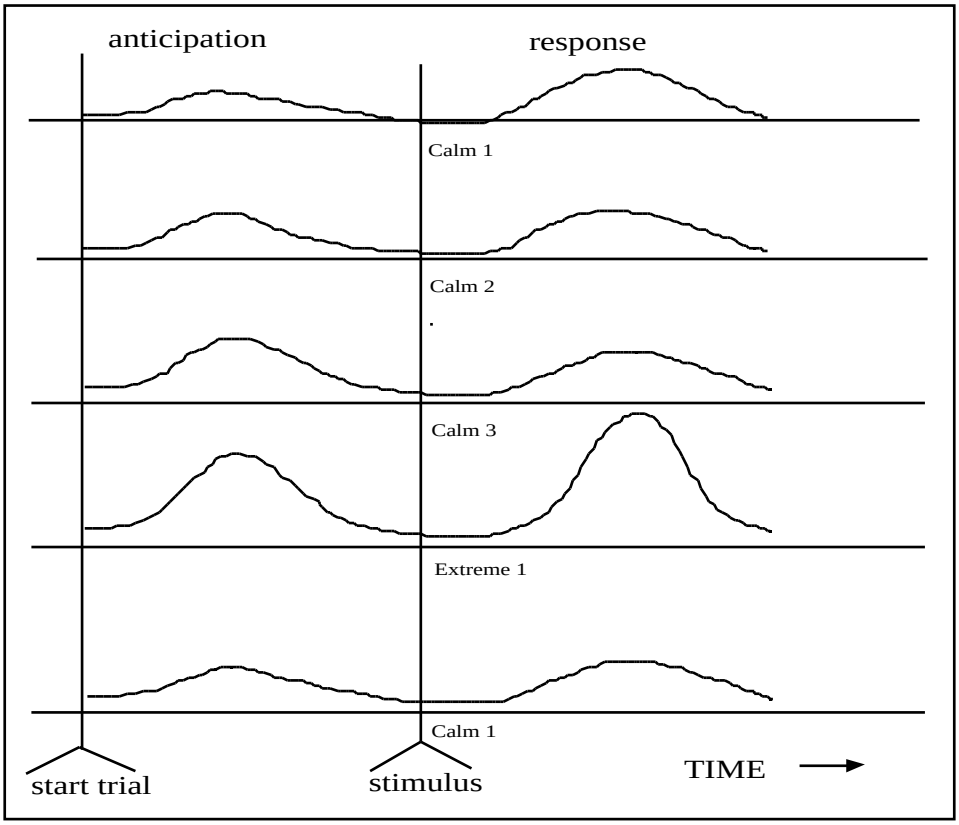


Figure 1: Changes in anticipation due to Gambler's fallacy

This possible explanation of the differences found by Radin is one of the driving forces for the different experimental designs in the Amsterdam replications[1].

Generally this series deals with the potential problem of sequential effects in 3 ways:

a) First, experimental manipulations, like the manipulation of the ratio between calm and extreme pictures, are applied that supposedly should be sensitive for sequential strategies and should result in differential effects due to these strategies.

b) Secondly, experimental manipulations, like the manipulation of exposure times, are applied which should be insensitive to these strategies. Any differential effect for these conditions would strengthen the psi hypothesis.

[1] After the submission of the first draft of this paper, elaborate computer simulations of these potential strategies and their effects were performed by the author and by an independent sceptic. It turned out that the effects as described above only emerge in a closed deck situation and therefore cannot explain Radin's original results (see also discussion section).

c) Thirdly, two experiments use uninformed participants and the experiment is finished after the first extreme picture is presented.

Of course secondary analyses where only presponses to calms and extremes are used that are matched for sequential position can further elucidate the potential normal explanation in terms of sequential effects.

2. General procedure and specific set-up of the 5 studies.

A participant sits in a comfortable chair in a dimly lit room, the index and middle finger of the left hand connected to a skin resistance measurement device. In the instruction the experimenter emphasises that the subject should try to experience each trial as a complete new one. After the instruction and one or more demonstration trials, the experimenter leaves the room and the participant may start the first trial by pressing a key on the keyboard. After 7.5 seconds, a period that we call the *fore period*, a randomly chosen picture, either calm or highly emotional, is displayed for a specific exposure time (for randomisation details see appendix 1). Before, during and after exposure the skin conductance is sampled by the computer with a sampling rate of 5 or 10 samples per second. The 5 studies share this general procedure but they differ in composition of the stimuli, in exposure times and in added psychological tasks.

A review of the parameters in the 5 studies is given in table 1

Table 1: A review of current presentiment studies

Study	Period	# Ss	Pictures	Exposure times	# trials	samples/ trial	Added task
1	9/96-11/96	16	40 extreme, 80 calm/ 3 sets with 3 ratios (1:3, 3:7, 1:1)	400 ms 3000 ms	40	73 (5 Hz)	None
2a	2/97-3/97	32	1 extreme / 9 calm	400 ms 3000 ms	10	87 (5 Hz)	None
2b	2/97-3/97	see 2a	6 extreme/18 calm	400 ms 3000 ms	24	87 (5 Hz)	None
3	2/97-4/97	16	32 odd trials: random dot picture even trials: 4 * 8 trials: (2-6; 4-4; 2-6; 4-4 randomised per 8)	100 ms 600 ms	64	150 (10 Hz)	categorisation task on each trial
4	4/97-5/97	126	odd trials: word stem completion .task even trials: see 3.	200 ms 3000 ms	64	150 (10 Hz)	word stem completion task
5	4/97-7/97	64	see 2a: extreme picture is lateralized	200 ms	10	87 (5 Hz)	categorisation task

Study 1 is a rather straightforward replication of the experiments reported by Radin (Radin, 1996). However the following modifications were made. Rather than selecting pictures completely random from the total pool, pictures are organised in three sets with different ratios between calm and extreme pictures. The set is chosen randomly at the beginning of each experiment such that the ratio is even unknown to the experimenter. Then the pictures in the set are shuffled and presented in the shuffled order. Thus all pictures in the set are presented. It should be remarked at this point that this randomisation procedure is done at the start of the presentation of the first trial and therefore an interpretation of the results in terms of clairvoyance rather than precognition is allowed.

Furthermore, rather than having different exposure times between studies like in Radin's paper, we introduced this variable as a within subject variable. There are always two possible exposure times. Each of them is randomly selected with a probability of 0.5 .

Study 2 consists of two parts. During the first part (a) the subjects are told that 10 pictures will be presented in order to establish a baseline in the physiological behaviour. According to this cover story the real experiment will begin after establishment of this baseline.

Unknown to them in this first part there will be a single extreme picture presented at a random sequence number between 3 and 10. For about half of the subjects this extreme picture is the most extreme pornographic for the other half the crucial picture is the most extreme violent.

Before the start of the second part (b) the subject is completely informed about the fact that there will be more extreme pictures and thus the subject may use similar anticipation strategies as in study 1. Study 2b uses only one ratio (one extreme for every three calms) between extremes and calms, moreover uses only 48 pictures form the original 120 pictures. These 48 pictures were selected on the basis of their stronger effects in study 1.

In **Study 3** there are 64 trials. For each odd trial a meaningless random dot pattern is used as picture. For the even trials the randomisation is such that the ratios are made different for four quarters in the total sequence in order to test for a ratio effect within subjects and also to reduce the habituation which would occur if subjects get an over-all 1:1 ratio of extreme : calm pictures.
In this study subjects are informed about the fact that there are pictures of emotional content but rather than just experiencing the pictures the subjects are asked to detect a randomly located geometric object (rectangle or a circle) and press a corresponding key when they have found this object which is superimposed on the picture. This object remains on the screen even beyond the exposure time of the picture.
For the first three quarters of the trials the subject is asked to focus on correctness of the response while only for the last quarter the subject is asked to focus on speed of (hopefully correct) response. Secondary non-psi hypotheses were formulated concerning the interference of the emotional content of the background picture with this classification task.

Study 4: Resembles study 3 but on the odd trials, rather than using a random dot pattern picture, a completely different task is performed. This is a so called subliminally primed exclusion word stem completion task (Merikle, 1995). The responses on this task are used to classify subjects for reliance on non conscious processes.
In study 4 the student experimenters take the role of subjects and are completely unaware of the psi hypotheses that are explored later by the supervisor. Their focus of attention is on the non-psi relations between emotional, cognitive and non conscious processes.

Study 5: Resembles study 2a because it will use only a single extreme stimulus. This stimulus will be lateralized, i.e. present the emotional content to either the left or the right visual field. The categorisation task as described in study 3 will be presented in the centre of the visual field and will function as a fixation point. Subjects are selected according to their dissociability: high dissociable and low dissociable.

2. 1 Stimulus material

The basic stimulus material is identical to the set of pictures that has been used by Radin (1996). It consists of 80 calm pictures and 40 extreme pictures of a violent, erotic and pornographic nature. This basic set of pictures was slightly updated by the student experimenter in study 1. She adjusted the set for cultural differences, most notably replaced a few erotic pictures that would not be seen as very arousing in Europe with more extreme pictures. A snapshot review of the updated set and other information on this study is available through Internet (http://www.psy.uva.nl/emo_int.1). For the studies 2, 3 and 4 a subset of the 120 pictures of the basic set was used. This selection was based upon a qualitative evaluation of the effect of each of the pictures in study 1. For the categories, violent and pornographic, the most effective pictures were selected while for the calm category a random selection was made. In the category 'violent' we included piercings even if the piercings concerned sexual locations. The pornographic pictures were of, both homosexual, and heterosexual nature. We did not make an effort to study the differential effects between these two sub-categories. In study 5 the lateralized pictures are constructed from pictures in the International Affective Picture System (IAPS) which is a generally well accepted set of pictures used in research into human emotion (Greenwald et al, 1989).

2. 2 Subjects

The subjects in all studies except studies 4 and 5 (see above) are recruited from the circle of friends or acquaintances of the experimenters.

2.3 Dependent variables

The dependent variable in all studies is the behaviour of the skin conductance during the 7.5 seconds preceding the stimulus (the fore period). Dependent on the sample rates (of 5 or 10 Hz) these are either 37 or 75 highly correlated data points. This between sample correlations and the large number of data points presents us with a problem of how to collapse the skin conductance during the fore period into a single dependent value in order to prevent over-analysis.

In the first study, the results of which are reported in this paper, we defined the dependent variable as the mean values of the samples between 2.5 seconds and 0.5 seconds preceding the stimulus (the critical interval in figure 2) corrected with a baseline value obtained from the samples between 0.6 and 2.6 seconds after the subject started the trial. This specification of the dependent variable, hence called ***P***, and the nonparametric method of analysis to be used was made public before the experiment started. Currently we are developing an exact (permutation) method to calculate the significance levels of different wave forms during the fore period (see appendix 2).

2.4 Independent variables.

In the studies the following independent variables are used:

a. Type *of stimulus (StimType)*; For each study this within subject variable has two values: calm and extreme. In the category extreme we discern two sub-categories: violent and pornographic. In study 2a the type of stimulus is a between-subject variable.

b. Exposure *Time (Exp.Time)*; For each study this within subject variable has two levels.

c. Subject variables (Ss-X). The gender of the subjects is an important variable because in normal research on the physiology of emotions gender- typical effects have been reported (Greenwald et al, 1989).

d. *Ratio* between calm and extremes

3. Hypothesis, expectations and explorations in the current research program.

Formal hypothesis

1. over-all presponse effect

There will be a difference in presponse patterns for different stimuli categories.

2. exposure time effect

The presponse pattern effect is larger for short exposure times than for long exposure times. This hypothesis is based upon qualitative differences between suboptimally(short) and optimally (long) exposed stimuli found in research on cognition and emotion. The emotional stimuli showed relatively greater effects for short (suboptimal) exposure times (Murphy & Zajonc, 1993).

Explorations

- We will explore the differential effects for calms and extremes matched for sequential position.
- We will explore the effects on the presponse pattern distribution for different extreme : calm ratios.
- We will explore the effect of different categories of extreme stimuli, most notable the category of violent stimuli vs. the category of pornographic stimuli.
- We will explore the effect of lateralized exposure.
- We will explore subject variables.

4. Results of first Study

At the time of writing of this paper three studies are finished, and two are in the process of being carried out. The data of the first study have been analysed and will be presented below. The data of the other studies will hopefully be available at the conference.

4.1 Subjects

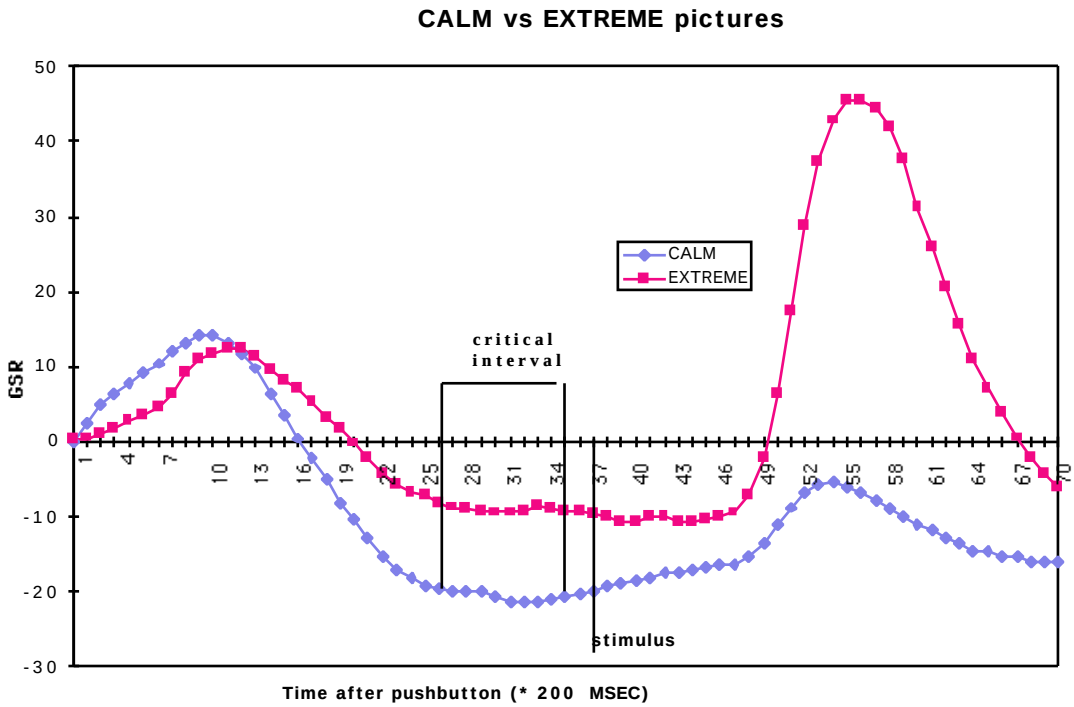
In study 1, 17 subjects were tested, 3 male and 13 female, whose age ranged between 22 and 57. However one subject had to be removed because of apparatus failure.

4.2 Formal hypotheses

Each subject did 40 trials, so the total data set consists of 16* 40 - 640 epochs of GSR. From these 640 there were 428 obtained with a calm stimulus and 212 with an extreme stimulus.

Hypothesis 1 : presponse dependence on stimulus category

In figure 2 the average response is given for the calm epochs and for the extreme epochs. No error bars are indicated because error bars presuppose normality of the data-distribution.



To increase readability of the graph we have clamped the mean of the first sample on 0. The formal test consists of calculating the presponse ***P*** according to the definition given in the section on dependent variables and performing a Mann Whitney U test on the scores obtained preceding the calm and preceding the extreme stimuli. The resulting z-score is: 2.7 with a corresponding p-value of 0.007. (It may be noted that a 2 sample t-test yields a t of 2.65 indicating that the non-parametric test has a little bit more power given the non normal distribution.)

Hypothesis 2: :Exposure time effect

In figure 3 the average difference in presponse between extreme and calm is given for long (3000 msec) and short (400 msec) exposures.

Although the differences are in the predicted direction, i.e. the presponse effect is larger for short exposures (in contrast to the response effect) the differences when formally tested are non significant. (Mann Whitney U: z-value = 1.09, p = 0.27).

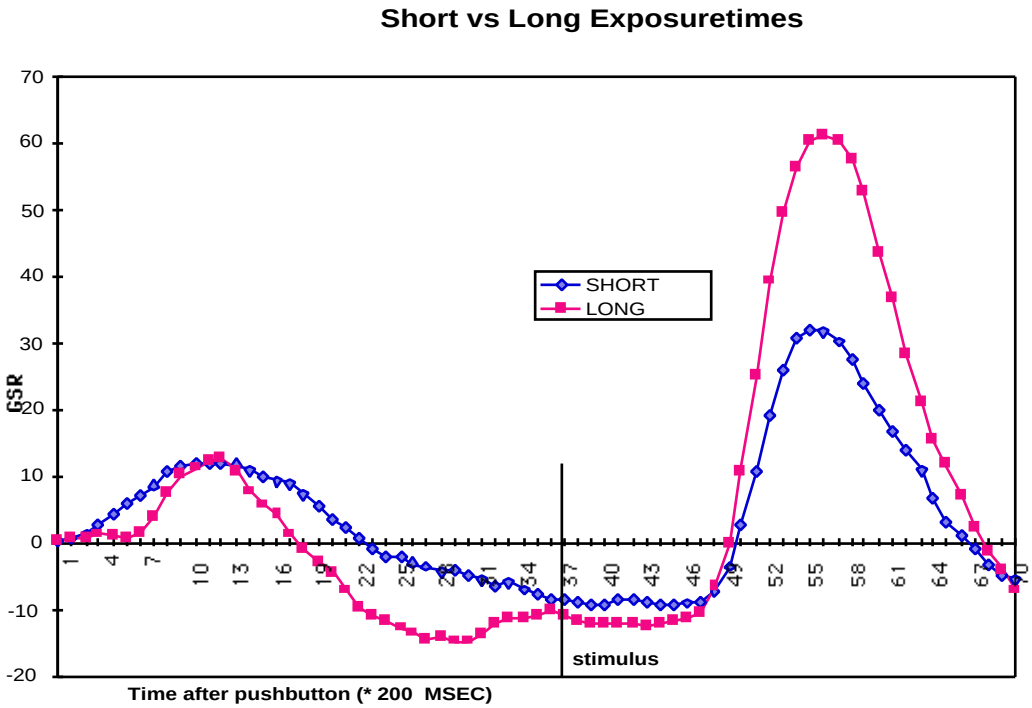


Figure 3: The average difference in presponse between extreme and calm trials for two different exposure times.

4.3 Explorations

4.3.1 Ratio effect

In order to evaluate the effect of different ratios, an ANOVA was done using Type of stimulus, Exposure time and Ratio as factors and the ***P***-score as dependent variable. Given the non-normality of the ***P***-score distribution this turns out to be a slightly conservative approach. The results showed that the mean presponse for all stimuli, calms and extremes was heavily influenced by the ratio ($F= 30.47$, $df=2$, $p<0.0001$). This is due to the fact that ratio is a between subject variable and subjects do differ greatly with respect to psycho physiological responsiveness. None of the interactions however was significant indicating that the ratio extremes:calms was of no influence on the calm vs. extreme presponse effect. In table 2 the mean difference in ***P***-values are given for the three different ratios.

Table 2: Relative effects for different Calm: Extreme ratios.

Calm : Extreme	no. of subjects	long	short exposure
1:1	6	-0.3	5.6
3:7	3	4.8	-6.8
1:4	7	-12. 4	18.8

4.3.2 Extreme Category effect

In figure 4 we have plotted the mean presponse pattern for pornographic pictures and for violent pictures (NB the mean **calm** presponse is subtracted from both means).

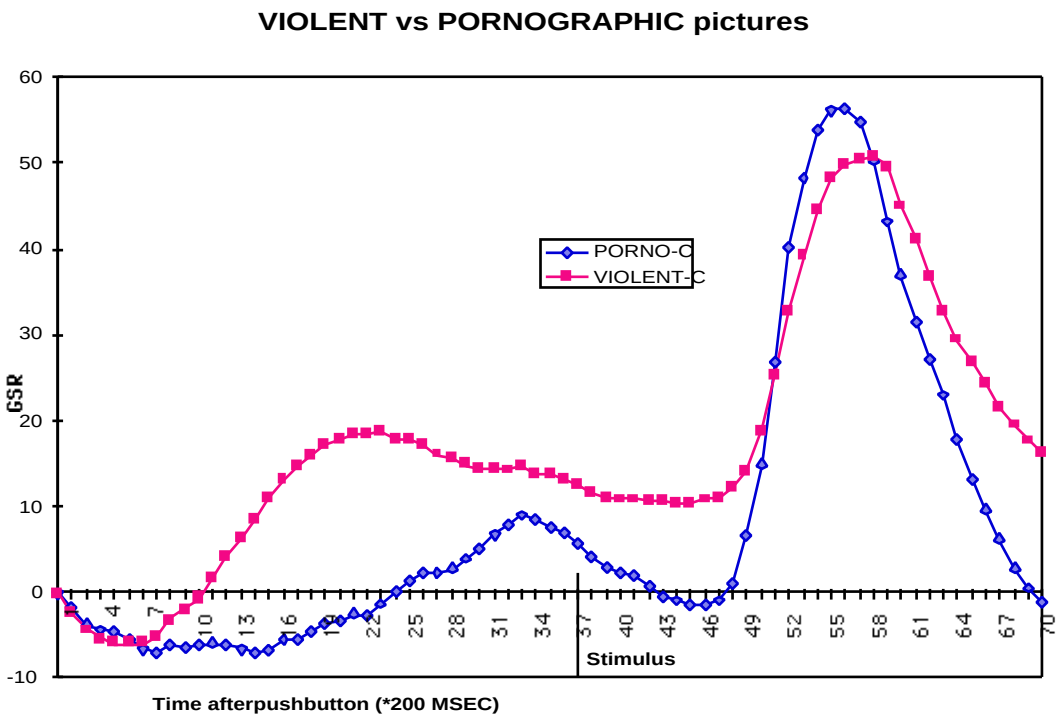


Figure 4: Difference in Skin conductance vs. time between Pornographic and Calm stimuli and between violent and calm stimuli

Since no specific predictions were made concerning different types of extreme stimuli, we compared the **over-all** response patterns rather than a specific critical period for both categories of extreme stimuli using the ANOVA with repeated measures method described in appendix 2. In order to do this we reduced the first 40 data points preceding the stimulus to 8 data points by averaging over 5 samples (1 second). That by doing so the last data point contains 3 samples (600 msec) after stimulus exposure started is not problematic because GSR latencies about 3 seconds. This test gave a marginal significant result ($F=2.18$, $df=7$, $p=0.033$) but we should realise that it is a post hoc test.

4.4 Matching for sequential position

In the previous analyses the means of the presponses were calculated independent of the sequential position of the specific stimulus. So the average of the calm prepsonses is composed of presponses of calm trials that were preceded by another calm trial but also of calm trials that were preceded by an extreme trial. This pooling of trials with different sequential position may result in artefacts as described in the introduction.

One solution to this problem is to compare trials only if they have an identical sequential history. The trials in study I were therefore broken down according to their sequential history. We then compared the last Calms and Extremes with the following histories:

lag1: Extreme-Calm vs. Extreme-Extreme

lag2: Extreme-Calm-Calm vs. Extreme-Calm-Extreme

lag3: Extreme-Calm-Calm-Calm vs. Extreme-Calm-Calm-Extreme

lag4: Extreme-Calm-Calm-Calm-Calm vs. Extreme-Calm-Calm-Calm-Extreme

The results for the different lags are graphically presented in figure 5.

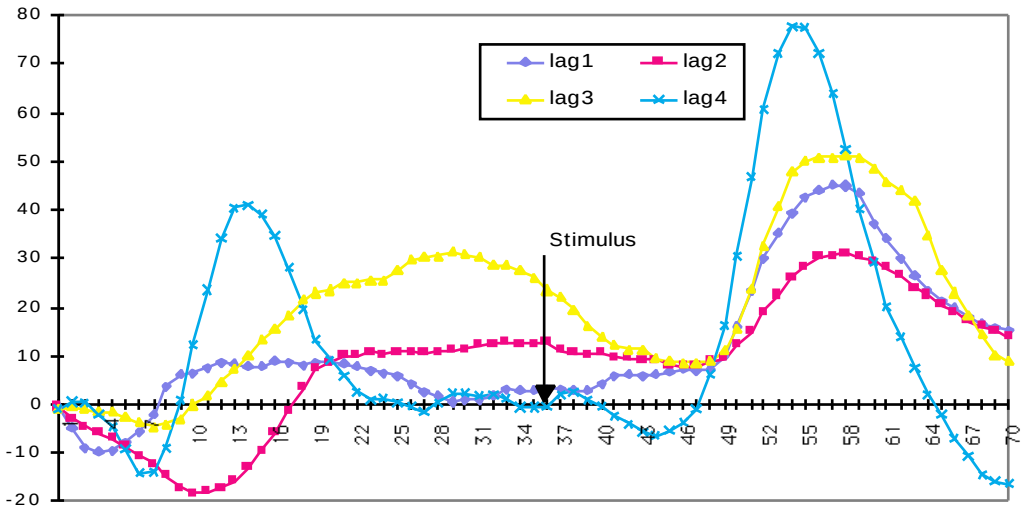


Figure 5. Differences between mean presponse on Calm and on Extreme stimuli with matched sequential history.

It can be seen that, although there are different wave forms for the different timelags, the over-all picture is the presponse for extremes is larger than for calms. Separate Mann-Whitney U tests yield the following z scores:

Lag	z-score	Ncalms	Nextremes
1	0.30	146	77
2	1.74	96	46
3	2.86*	59	34
4	1.15	42	16

All further lags have also a positive z-score. A weighted sum of the 4 different analysis is given in figure 6 and shows basically an identical result as figure 2.

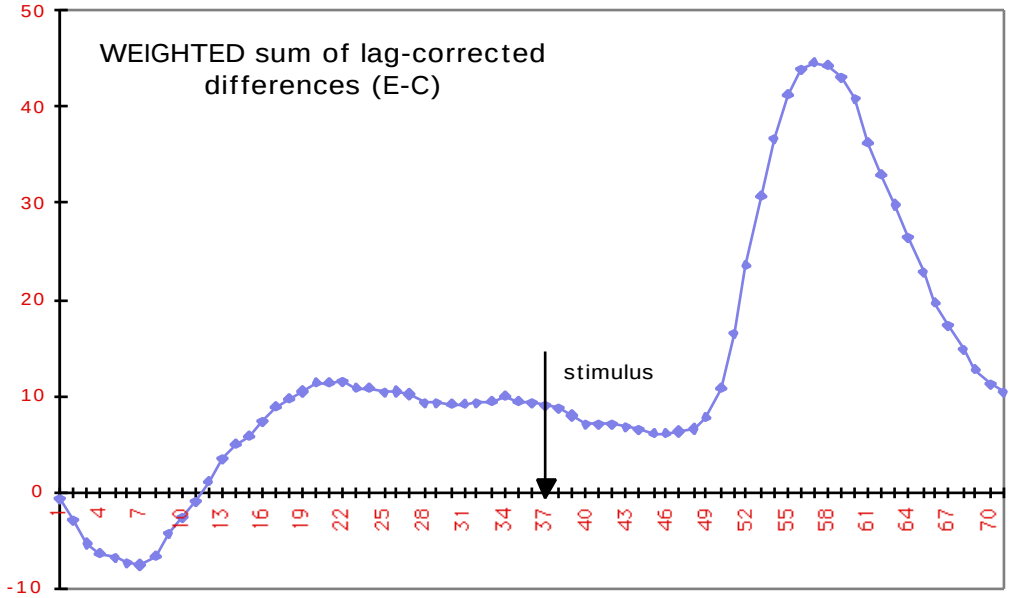


Figure 6: Weighted sum of presponse differences between Calms and Extremes over 4 different sequential histories.

5.Discussion

Is presentiment a paranormal phenomenon?

The main effect of the results of study 1, indicating that the physiology of subjects adjusts to future randomised conditions, does very much look like a paranormal precognitive effect. However the apparent robustness of the phenomenon should alert any scientist as in the past most laboratory psi phenomena did behave rather elusively and there are even theoretical notions as well as psychological explanations for this elusiveness.

Radin has adequately treated a number of potential normal explanations of the effect. The current replication with completely different hard- and software does strengthen the conclusion that the results can not be explained by a technical artefact.

The major (and maybe only) source of normal explanations left after Radin's studies was the hypothesis that subjects developed anticipatory strategies that would result in artefactual different anticipatory physiology preceding calm or extreme pictures. As was explained in the introduction this seems at first sight a real possibility. The current results however hardly support this notion because the presponse effect seems not to be dependent on ratio between calm and extremes in a systematic way that should be expected if anticipation strategies based upon the Gambler's Fallacy were employed.

There are three further arguments against an explanation in terms of normal anticipatory strategies. The first one of these is that we find suggestive internal effects that can not easily be explained by this type of strategies. For instance, the difference between pornographic and violent stimuli. It would require anticipatory strategies that discriminate between the two types of extreme pictures to account for that effect. This holds also for the short versus long exposure effect.

The second argument is that an analysis that takes into account the sequential history givers basically identical results. Of course this analysis does not correct for possible strategies that are based upon doublets of extremes and the like.

The final argument is that computer simulations of anticipatory strategies, using ratios and total number of exposures that are also used in the current studies, do hardly show the expected main calm vs. extreme effects. It turns out that these simulations were extremely sensitive for the type of randomisation we used. If we used an random selection with replacement (open deck) the effects were small. If we used a random shuffling without replacement then the effects were large. This finding came as a surprise because the reasoning as sketched in the introduction has such a direct appeal.

The following anticipatory strategies were tested:

a) increase anticipation by 1 unit after each calm and resets anticipation to 1 after each extreme.
b) double anticipation after each calm (with a maximum of 500) and reset the anticipation after each extreme to either half or 1.

The simulated effects in the open-deck situation were never larger than 2% while the experimental effects are generally larger than 10%.

However these analyses are by no means exhaustive and there maybe less plausible models that may result in larger differences although the present author is doubting if this will turn up in the open deck situation.

The major point in favour of the psi hypothesis is however that there are no indications in the real data that support any of these sequential strategy models so far. (This study, and Radin, 1997)

Is it an experimenter psi effect?

The first successful experiment along this line was done by Dean Radin who is known to be successful with about any experiment that he does. Therefore we decided in study 1 to split the subjects before analysis in two parts. Odd subjects were analysed by Radin and even subjects by the main experimenter on this side of the ocean. It turned out that the effects were present in both data sets, slightly stronger in the set not analysed by Radin. This is another sign of the robustness of the data.

Why did Hartwell fail?

The fact that presponses are larger when the pictures are rated by the participant as more extreme (Radin, 1997) does strongly suggest that this type of presentiment only occurs when the future stimulus is highly emotional. In Hartwell's work the future stimulus may be liked or disliked but the emotional content was quite moderate. Furthermore Hartwell calculated the power of his experiment and his rather complicated

analysis procedure that involved Fourier analysis and component extraction. It turns have shown some significant results. In the current studies the presponse is between 10 and 30% of the main response. Therefore, even if Hartwell had used similar emotional stimulus material, he probably still would have had insufficient power to establish the effect to a significant degree.

What next?

The presentiment studies may offer a handle to obtain the attention of mainstream science, and especially of mainstream psychology due to the following reasons:

1. The data may be presented as an anomaly that has some direct consequences for all studies in psychophysiology which use baseline measurement preceding the stimulus. These baseline measurements are assumed to be non dependent on the randomised aspects of the stimuli. Traditionally the present data can be interpreted as showing that the counterbalancing which is generally used in this type of experiment is insufficient because there seem to be extremely subtle sequential effects. In fact this approach was used in the recent note in a mainstream Journal. (Bierman & Radin, 1997)
2. The effect may be presented in the light of the new interest in the study of intuition. Intuition can be seen as a form of non conscious problem solving (Bechara et al, 1997). This has been an ignored research area but with the new interest in the study of non conscious processes and its relation to emotions we may be able to sneak in the notion that there may be a speculative other (precognitive) component to intuition.
3. The research can be fruitfully done within the context of main stream research. Studies 3 and 4 of the present series show this approach. These studies will eventually appear in mainstream journals and the relevant data sets are subsequently part of the mainstream data base. By the same token, some of the main stream data already published, like those of Bechara et al, may carry the effects although (still) unknown to the original experimenters.

Acknowledgements

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Appendix 1: *Randomisation details.*
Proper randomisation of the presentation order is a critical element in this type of experiments because the basic assumption is that the participant can by no normal means know what the following stimulus may be. Stimulus-arrays were shuffled using a pseudo random generator based upon the standard random function in the CodeWarrior C programming environment (CodeWarrior for Macintosh, version 8.). Sources of the software are available through Internet . (http://www.psy.uva.nl/emo_int.1)

Appendix 2: *Technical specification of the dependent variables.*
In the first place one can specify a small time interval for which the average will be taken as the dependent measure. This is the approach used in study 1. The disadvantage of this approach is clearly that at this stage in the research paradigm we feel that we do not know enough about latencies (i.e. the times at which presponses arise) to precisely predict where in the 7.5 seconds the effect will appear. Also it could be that latencies are dependent on the type of stimulus. For instance presponses on erotic stimuli may peak at another time than presponses on violent stimuli. So it is preferable not to limit the dependent measure to a too specific time interval.
The second way therefore is to use all the data points as a repeated measure of the same variable PresponseTS (TS for time series). The basic hypothesis is then that this PresponseTS, which is a vector in a multidimensional space (where the axis are not orthogonal), differs for different type stimuli. This could in principle be tested with an ANOVA with repeated measures where the type of stimulus is a between subject variable and the time series is the repeated measure. The F-value of interaction between the two would give a direct measure for this difference. This approach assumes equal correlations between all points of the time series (sphericity) which generally is easily violated. Corrections tend to greatly reduce the power of this analysis, a power which is not very high anyway. The analysis also assumes normality of the data. The analysis is not very sensitive to deviations from this normality however.
Another approach is to reduce the dependent data points of the time series by principal component analysis to a few orthogonal factors. This techniques has been used successfully to analyse evoked potentials. A part form normality of the data points there are no further assumptions for this reduction technique. After reduction of the data points a two way analysis of variance with the type of target as well as the dimension of the orthogonal factors may be used to do the overall analysis.
Recently it was shown that rather than using the analytic approximations, the calculation of an exact level of significance is the more sensitive method (Blair & Karniski, 1993). This approach which basically calculates a score distribution based upon the actual measurements and used that distribution to calculate the p-value is free of critical assumptions. Software has been developed to analyse all data using this permutation method and results will be available at the conference.

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