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Sex Pairings, Target Type and Geomagnetism in the PRL Automated Ganzfeld Series

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Abstract

During their ten years of operation the Psychophysical Research Laboratories (PRL) produced a rich and complex database using the automated ganzfeld system. This database continues to provide valuable insights and hypothesis-generating information to those doing current ganzfeld work, as well as those seeking to understand the participants who take part in such research. This paper reports on several analyses of the PRL database. These analyses are meant to be purely exploratory and cover several different aspects of the PRL automated ganzfeld dataset. The first of these are sex (female or male) pairings between the session teams of experimenter, sender and receiver. These teams are broken into groups of sender/receiver pairs tested by female experimenters; sender/receiver pairs by male experimenters; and finally sender/receiver pairings for the overall PRL database. Next, target type (Dynamic/Static), is reviewed in relation to sender/receiver relationship, extroversion and introversion, and competitiveness. Finally, a geomagnetic analysis using the daily AP and hourly ap values was conducted for the entirety of the PRL ganzfeld-database. The results of these analyses are discussed in the hopes that the findings may be of some help to researchers who wish to further explore the rich findings of ganzfeld research in general, and the PRL automated ganzfeld database in particular.

Introduction

Psychophysical Research Laboratories closed its doors in 1989, leaving behind it the legacy of a rich and complex database. This is especially true of its ganzfeld research program. With more than 350 trials over a 10 year span, it stands as the largest gathering of ganzfeld material from a single laboratory, and is still the most comprehensive exploration and gathering of social information on a single effect within parapsychology. This database continues to provide the field with informative and reliable material from which a wealth of continuing research continues to progress. It is on aspects of the automated ganzfeld research at PRL that this report will focus.

The ganzfeld was developed at PRL into the automated system that was the early precursor to several of the high tech systems in use today (see Dalton et al., 1994, for a description of the Edinburgh automated ganzfeld system). It met several of the requirements that past research indicated seemed to facilitate psi success, such as reduction of both external and internal distractions. Additionally, unlike some other psi testing procedures, such as card guessing studies, the ganzfeld provides a novel and stimulating experience for participants. It is a unique opportunity for the exploration of altered states of consciousness, mental imagery and personal symbolism. It also provides for exploration of psychological openness and in-depth awareness of one's own mental processes.

The eleven automated ganzfeld studies conducted at PRL are among some of the strongest evidence for the existence of psi phenomena produced, and have been accorded a rarely achieved measure of recognition outside of the parapsychological field (Atkinson, Atkinson & Bem 1990; Bem and Honorton, 1994). The autoganzfeld experimental program included three pilot and eight formal studies. Five of the formal studies employed novice (first time) participants who served as the receiver in one session each, and the remaining three formal studies employed experienced participants. Altogether 100 men and 140 women participated as receivers in 354 sessions during the period of this research program and eight separate experimenters conducted sessions during this time. The overall hit rate for the combined autoganzfeld studies was approximately 34%. This is nearly identical to the effect size found in an earlier meta-analysis by Honorton (1985) of ganzfeld work from various labs, and is highly significant ($p = .0009$).

While the PRL automated ganzfeld database has been explored elsewhere in terms of the relationship between hit rates, Honorton's four factor model of success and other psychological and physical variables (for summaries of this work see; Bem & Honorton, 1994; Honorton et al., 1990), the database still remains untouched in many areas. Very little is known about the relationship of these successful sender/receiver pairs, or whether factors such as sex, competitiveness, or type of target may have had some bearing on their success. In the hope of helping to inform current research, it was decided to present these results as purely exploratory in nature and designed to provide hypothesis-generating insights for future approaches within automated ganzfeld research.

The first area under scrutiny is that of sex of participants on the relationship between experimenter, sender and receiver. A typical ganzfeld session takes upwards of two hours and requires a large amount of personal interactions, which include both rapport building and one-to-one dialogue between the experimenter and their participants. For this reason, the ganzfeld is seen by some as an intensely social setting in which sex interactions between both participants and experimenter may contribute significantly to success (Dalton, 1994). Research in social psychology (Anderson & Blanchard, 1982) has indicated that male/female combinations may give superior results in experimental settings involving a problem-solving task. A meta-analysis by Wood (1987) showed that mixed-sex outcomes tended to be better than single-sex outcomes when considering frequency of study outcomes comparing these two groups. A study by de Angelis (1987), which looked at adults working on a problem-solving task in mixed and same sex pairings, from separate rooms linked by video, found that mixed-sex pairings were more efficient at problem-solving than same-sex pairings. In many respects, the ganzfeld may be considered a problem-solving task in that the joint efforts of the sender and receiver are required to find ways to send and receive appropriate psi information in order to correctly select the right target. Because the social psychology literature also includes some suggestion that the sex of the experimenter may affect the performance of the participant on tasks (Harris, 1971; Rumerick et al, 1977), and as the ganzfeld may be perceived as some as an intense social interaction between experimenter and participants, this variable deserved some looking into. The sex pairing results from the PRL database are compared to the results from the Dalton (1994) study which analyzed sex pairings within her own study as well as two other studies by female researchers.

The next section is an exploration of target type in relation to certain personality and social factors. Since the hit rates were so different for static versus dynamic targets (27% versus 41%) it made sense to examine relationships separately for the two target types. A multitude of variables exist for possible exploration, and we discuss just three. The ones we explore are admittedly eclectic, coming to our attention from others rather than being selected by us, as explained in the text. We examined hits and misses based on whether or not senders and receivers were friends, whether the receiver was an extrovert or not, and whether the receiver was high or low in self-rated competitiveness.

The final section in this report looks at the relationship of the PRL database to the geomagnetic field. There has been a growing interest in the relationship between the earth's geomagnetic field (GMF) and its possible relationship to psi. Past studies have produced evidence that psi perception may be best when the GMF is relatively quiet. These studies (Arango & Persinger, 1988; Berger & Persinger, 1991; Haraldsson & Gissurarson, 1987; Lewicki, Schaut & Persinger, 1987; Persinger & Schaut, 1988; Persinger, 1985, 1987, 1989; Persinger & Krippner, 1989; Schaut & Persinger, 1985; Spottiswoode, 1990, 1993; Wilkinson & Gauld, 1993) provide an increasingly large body of evidence suggesting a relationship between psi performance and fluctuations in the GMF and have led us to investigate this relationship within the PRL database.

A geomagnetic analysis conducted by Persinger (1989) made use of data collected by PRL for 139 participants, and showed no significance. As that can be considered a partial analysis of the completed PRL database (354 participants), we feel it is appropriate to present the full data here. In addition, while Persinger reported on the mean aa values for the days prior, during, and after the ganzfeld experience for those participants, we have conducted our analysis using the daily AP and 3-hourly ap values, and these values only for the day of the actual ganzfeld session. As the Ap uses measurements from 13 monitoring stations rather than just two it was felt to provide a better overall global daily measure. The analysis we report here is conducted on the entire database of 354 participants. A description of the procedure that these participants followed at PRL labs is provided to allow the reader a more complete information base.

Procedure

For a more detailed description of the laboratory layout, and the procedure involved, see Honorton et al (1990). However, for completeness as to what a ganzfeld session entailed, a summary of the procedure used at PRL is included here. Before arriving at PRL first time participants (novices) were asked to complete the Participant Information Form (PIF) developed by PRL, as well as Form F of the *Myer-Briggs Type Indicator* and to bring these with them to their first session. They were also asked to bring a sender for the session, someone with whom they felt a connection. If this was not possible, a PRL staff member served as their sender. Participants were greeted at the door and offered refreshments during a period of chat time during which a friendly, informal atmosphere prevailed. After describing the rationale and background of the procedure and creating a positive mind set towards successful acquisition of the target mentally, the participant and sender were shown the sender's room and the experimenter's room before proceeding into the receiver's room.

In the receiver's room, the receiver was seated in a comfortable reclining chair while the experimenter prepared the receiver for visual and auditory ganzfeld stimulation. Translucent hemispheres (halved ping-pong balls) were taped securely over the receiver's eyes with surgical tape and headphones were placed over the receiver's ears. A clip-on microphone was clipped to the receiver's collar, and a 600-watt red-filtered floodlight, (approximately 6 ft. in front of receiver's face) was adjusted in intensity until a comfortable, shadow free, homogeneous visual field was achieved by the receiver. The white noise level of the relaxation tape was also adjusted by the receiver at this time.

The sender then departed for the sender's room and also sat in a comfortable reclining chair. They faced a color TV monitor and wore headphones through which they would hear the receiver's mentation report and, for targets having it, the audio channel of the target. Both receiver and sender remained sequestered in their respective rooms until the receiver had completed the blind judging procedure at the end of the session.

As the ganzfeld session began, both the sender and receiver listened to a 14 minute relaxation tape. At the end of this 14 minutes, the receiver began to hear white noise for a period of approximately 30 minutes and was asked to speak out loud during this time about all thoughts, images, and feelings as they occurred. The experimenter audio taped, and hand noted, this mentation for review after the sending period. At the beginning of the white noise the sender's TV monitor displayed a prompt to the sender telling them to silently communicate the contents and meaning of the target about to be shown, to the receiver. Two types of targets were used — "static" targets, which were video taped still photographs, and "dynamic" targets, which were short video segments. The sender saw the target a total of six times during this 30 minute sending period.

At the end of the sending period, the experimenter reviewed the receiver's mentation with them, and then the computer displayed, for review one at a time, four possible targets in random sequence. After viewing each clip all the way through, as many times as they wished, the receiver's were then presented with a forty-point rating scale going from 0 to 100. Using a game paddle, the receiver indicated their rating for each target, with their first choice getting the highest rating, and each target getting a unique rating to prevent ties. The computer then converted these ratings into ranks. The sender was prompted by computer to silently direct the receiver to select the target that they saw during the sending period.

After the judging procedure (which was recorded and stored by the computer), the experimenter asked the receiver to tell the sender to leave the sender's room and join them in the receiver's room. The sender and experimenter entered the receiver's room and the sender revealed the target. Additionally, the target was displayed on the TV monitor in the receiver's room, and post session feedback began. Upon session completion, all files were backed up on the series data disks and the program automatically rewound the video tape to a central position. A hard copy printout of the session data was obtained and attached to the experimenters copy of the mentation/session notes and filed in a series binder. The audio tape of the session was similarly filed. (For additional details, see Honorton, 1990.)

After the closure of PRL, much of its equipment and the majority of its database for these sessions went to the Institute for Parapsychology in Durham, NC. In 1993, a database comprised of the information from these computer disks and records for these sessions was compiled and double-checked by Daryl Bem, Richard Broughton and Kathy Dalton. This database has become widely available, and it is from this that we have conducted the present analyses. A listing of the session information for each participant in the database can be found in Bierman (1995) in this volume.

Because of its widely acclaimed success rate, the autoganzfeld research at PRL has come under fire from a variety of sources. For a discussion of the debate concerning early ganzfeld research, we recommend the papers on the Hyman-Honorton debate (Honorton, 1985; Hyman, 1985), and the joint communiqué (Hyman & Honorton, 1986) in which they summed up their main areas of agreement and disagreement. For more current assessments of the PRL work, see Bem & Honorton, 1994; Hyman, 1994; Wiseman et al, 1994. This report will not attempt to assess the methodology and protocols of the automated ganzfeld series at PRL, but is instead intended to make public findings from analyses of that database.

Analyses

Several different aspects of the PRL database were examined for this report and each of these aspects will be presented in separate sections. The analyses in each section are exploratory in the sense that they were obviously not preplanned comparisons, and as such, the main purpose of presenting them is to provide impetus for further research.

Sex Pairings of Experimenter, Receiver and Sender

In a previous paper by Dalton (1994) an exploration of sex pairings and scoring rate within her own and two other small ganzfeld studies conducted by female experimenters was presented. To sum up that work, it was found that within the combination of these three studies, the receiver/sender teams of male/female sex pairings appeared to be the most successful, producing the largest effect size of the four possibilities at ES(h) = .61. The next most successful sex pairings were those of female/male, with an effect size of ES(h) = .52. Same sex pairings evidenced the lowest effect sizes, with the female/female receiver sender teams effect size at ES(h) = .35, and the male/male teams the lowest at ES(h) = .3. Thus, for the Dalton study the mixed sex pairings appeared to do best, evidencing the strongest effect size.

To examine this effect in the PRL data, we calculated effect sizes for the percentage of direct hits in trials contributed only by the individual groupings, that is, male/female (M/F); female/male (F/M); female/female (F/F); and male/male (M/M). There were six trials without a sender involved, and those are not included in this analysis, leaving a total of 348 trials. The data for female PRL experimenters is examined first, to allow for a more informative comparison with the data from the Dalton study. Table 1 shows the hit rate and effect size for the PRL female experimenters only.

Table 1
Hit Rate and Effect Size of Sex Pairings (Receiver/Sender)
of PRL Autoganzfeld Research for Female Experimenters Only

	MF	FM	FF	MM
Hit Rate	46%	41%	29%	30%
ES (h)	.44	.34	.09	.10

As shown by Figure 1 above, the PRL data for female experimenters seems to demonstrate the same pattern of successful sex pairings that was first noted by Dalton (1994), with

Figure 1
PRL Female Experimenter Sex Pairings

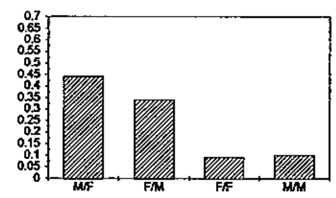
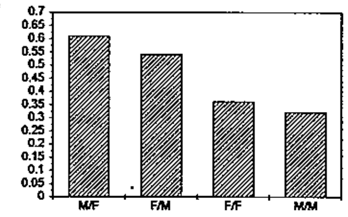


Figure 2
Dalton Combined Sex Pairs



similarly-valued effect sizes between the same sex pairings of female/female pairs and with the effect size of male/male pairs being reversed for the PRL population. Figure 2 shows the distribution of effect sizes by sex pairings from the Dalton study for comparison.

However, in looking at the data for the male PRL experimenters, this pattern is not present. The PRL data for male experimenters alone shows a surprisingly high success rate for female/female pairings (ES[h] = .37), and a surprisingly low success rate with female/male pairs (ES[h] = -.02). The hit rate and effect sizes for all pairings for PRL male experimenters only is shown in Table 2.

Table 2
Hit Rate and Effect Size of Sex Pairings (Receiver/Sender)
of PRL Autoganzfeld Research for Male Experimenters Only

	MF	FM	FF	MM
Hit Rate	36%	24%	42%	36%
ES (h)	.25	-.02	.37	.24

The distribution of effect sizes for the PRL male experimenters are shown in Figure 3. It is evident that the effect size for the female/male pairing for male experimenters falls slightly below chance, at ES(h) = -.02.

Finally, to allow for a comprehensive look at the PRL database, we calculated the effect sizes and hit rates for all four pairings, for male and female experimenters combined, to produce an overall picture of the sex pairings for the total PRL autoganzfeld research. These are shown in Table 3.

Table 3
Hit Rate adn Effect Size of Sex Pairings (Receiver/Sender)
of PRL Autoganzfeld Research
Overall PRL Results

	MF	FM	FF	MM
Hit Rate	41%	31%	34%	33%
ES (h)	.34	.14	.20	.18

Overall PRL Results

As can be seen in Figure 4, while the overall results demonstrate the same type of successful sex pairings between male/female pairs mentioned in the Dalton study and present in the female PRL experimenters data, the rest of the previously observed pattern is not present, with female/female pairings being the next most successful pairing overall. This is possibly due to the very strong result seen with female pairs in the male PRL experimenter data. In the overall PRL data, we found that the least successful pairings were that of female/male and male/male.

For completeness, Table 4 displays the overall hit rate and effect size achieved by the combined PRL female and male experimenters. As can be seen, there are no significant differences between the two.

Figure 3
PRL Male Experimenter Sex Pairings

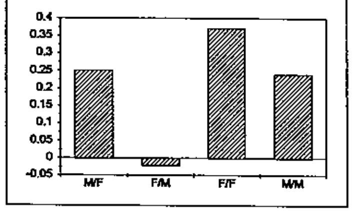


Figure 4
Overall PRL Pairings and Effect Size

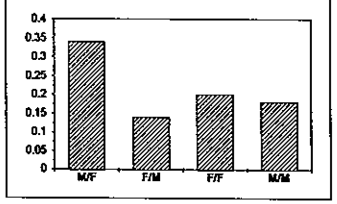


Table 4
Total PRL Hit Rate and Effect Size of Sex Pairings (Receiver/Sender)

	Female Experimenter	Male Experimenter
Hit Rate	36%	34%
ES(h)	.23	.20

Target Type and Success for Three Additional Variables

There were numerous personality and circumstantial characteristics measured for most of the PRL ganzfeld sessions. In this section, we present findings for three of those factors, showing that there were different patterns of success for static targets than for dynamic targets for each of these factors. The three factors are the relationship between the sender and receiver, whether or not the receiver was classified as an extrovert, and the self-rated competitiveness of the receiver. The analyses in this section are exploratory in the sense that they were obviously not pre-planned comparisons, and as such, the main purpose of presenting them is to provide impetus for further research. However, we did not find them by conducting multiple analyses from which these three factors emerged. These were the only ones we examined, for reasons explained in the text.

The first analysis resulted from a question arising at a seminar on meta-analysis, presented by one of the authors (Utts), for which the ganzfeld data were used as an example. Honorton et al (1990) had shown that the trials using static targets were not particularly successful, with only a 27% hit rate. Further, trials for which friends of the receiver were used as sender were slightly, but not appreciably, more successful than those for which laboratory staff members were used. These results were presented in the seminar.

A questioner wanted to know if the sender/receiver relationship had been examined separately for the static versus dynamic trials. He predicted that the relationship would be more important for static than for dynamic targets, reasoning that the dynamic targets produced such successful results anyway that this possibly left little room for the sender relationship to have an impact.

An examination of the data revealed precisely that pattern. As shown in Table 5, success rates for dynamic targets hovered around 41% (h = .35) regardless of the relationship between the sender and receiver. In contrast, for static targets when the sender was a friend of the receiver (including a laboratory staff friend), the hit rate was actually 31.4% (h = .14). Trials with static targets and a laboratory staff sender resulted in only 20.7% hits (h = -.10). Thus, the finding by Honorton et al (1990), that static targets produced nearly chance results, should be modified to include the distinction based on the sender. Trials with friends as senders were actually moderately successful even when the targets were static. (Due to the relatively small sample size and resulting low power, the exact binomial p-value for the 31.4% hit rate was not quite low enough to impose the arbitrary .05; it was 0.08.)

Table 5
Receiver/Sender Relationship

Target	Friends?	Hits	Misses	Total	% Hits	Cohen's h
Static	Yes	33	72	105	31.4%	.14
	No	12	46	58	20.7%	-.10
	Total	45	118	163	27.6%	.06
	χ^2	= 2.156,	p= .142,	phi = .12		
Dynamic	Yes	43	61	104	41.4%	.35
	No	34	49	83	41.0%	.34
	Total	77	110	187	41.2%	.347
	χ^2	= .003,	p = .96,	phi = .004		

We can use a chi-square test to determine the magnitude of the relationship between sender's relationship to receiver and success. For the static targets, we find chi-square = 2.156, resulting in a p-value of .14. The appropriate effect size to accompany this test is phi (see Rosenthal, 1991, p. 19). For the static targets, phi = .12. For the dynamic targets, the relationship is so weak that it is nearly at chance, $\chi^2 = .003$, p = .96 and phi = .004. In other words, it looks like friends and laboratory staff as senders work equally well for dynamic targets.

The remaining two factors discussed in this section were examined in a class project by Eric Suess, a Ph.D. student in Statistics at the University of California at Davis, and are presented here with his permission. He chose personality traits of particular interest to him (before examining the data) and decided to study whether or not certain personality factors influenced success rates. He decided to study the relationship among competitiveness, extroversion, target type and hit rate. Extroversion was already coded as a dichotomous variable; he categorized competitiveness from a self-report scale of 1 to 7 to low (1-3) or high (4-7).

The first finding (using log-linear model analysis) was that extroversion and competitiveness acted independently on the remaining factors, and could thus be examined separately. Although log-linear models should be used for complex relationships among three or more categorical variables, this finding of independence allows us to use the more familiar two-way tables and chi-squared tests. (Log-linear model analysis may also be used, and Suess's project took that approach.)

A technical note is in order here. To use chi-square tests we must assume that whatever relationship exists between the personality factor and success is independent from one session to the next. Because some people contributed multiple sessions, we must assume that their success or failure in one session was independent of their success or failure in the others, conditional on their personality traits.

Table 6 shows the results, separately for static and dynamic targets, and for extroverts versus introverts. Notice that for this trait it is the dynamic targets for which a difference emerges. Hit rates for static targets are similar for extroverts and introverts, at 26.1% (h = .03) and 28.4% (h = .08). For dynamic targets, the 91 sessions with extroverts produced a hit rate of 51.7% (h = .58) while the 82 sessions with introverts produced a hit rate of only 34.2% (h = .20). Testing for a difference in hit rates in this situation results in $\chi^2 = 5.38$, p = .02. phi = .18 for this relationship. For static targets the corresponding $\chi^2 = .077$, p = .78, phi = .02.

Table 6
Extroverts versus Introverts

Target	E/I	Hits	Misses	Total	% Hits	Cohen's h
Static	Extrovert	24	67	91	26.1%	.03
	Introvert	19	48	67	28.4%	.08
	Total	43	115	158	27.2%	.05
	χ^2	= 0.077,	p = .78,	phi = .02		
Dynamic	Extrovert	47	44	91	51.7%	.56
	Introvert	28	54	82	34.2%	.20
	Total	75	98	173	43.4%	.39
	χ^2	= 5.38,	p = .02,	phi = .18		

Finally, we examine the relationship between low and highly competitive receivers. Table 7 illustrates the results. Notice that for this factor, competitiveness appears to have a large impact for both static and dynamic targets. For the trials using static targets, competitive receivers had a hit rate of 34.0% (h = .20), while for those who were not competitive the hit rate was a very low 14.3% (h = -.27). The relationship resulted in $\chi^2 = 7.09$, p = 0.01, phi = .21.

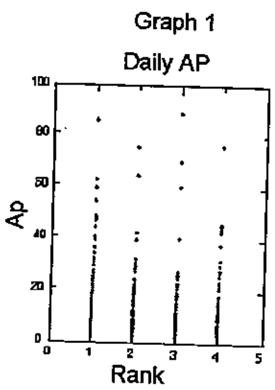
For dynamic targets the relationship was not quite as strong, but was still noticeable. Competitive receivers had a hit rate of 46.0% (h = .44) while noncompetitive receivers only had a hit rate of 34.3% (h = .20). The relationship between competitiveness and success resulted in $\chi^2 = 2.25$, p = .14, phi = .12.

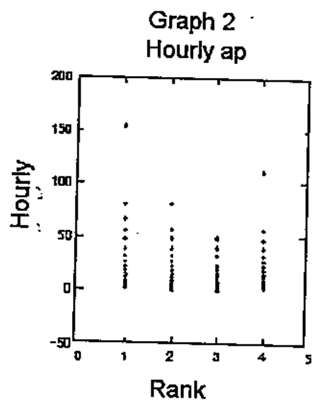
Table 7
High and Low Competitive Receivers

Target	Compete?	Hits	Misses	Total	% Hits	Cohen's h
Static	Yes	34	66	100	34.0%	.20
	No	8	48	56	14.3%	-.27
	Total	42	114	156	26.9%	.04
	χ^2	= 2.156,	p = .142,	phi = .12		
Dynamic	Yes	46	54	100	46.0%	.44
	No	23	44	67	34.3%	.20
	Total	69	98	167	41.3%	.35
	χ^2	= 2.254,	= -.13,	phi = .12		

The PRL Database and Geomagnetism

An analogy often used in attempting to explain the geomagnetic field is to liken it to the magnetic field surrounding a bar magnet. However, while the intensity of a typical bar magnet's field is measured in tenths of a Tesla, the GMF is normally measured in a few





hundred-thousandths of a Tesla. In addition, the GMF is constantly changing as the Earth is subjected to solar and other extraterrestrial influences, unlike the bar magnet whose field is static. These extraterrestrial influences show up in geomagnetic measurements as either periodic (e.g. the day-night cycle due to solar heating) or transient (e.g. cosmic ray events) fluctuations. These fluctuations are recorded and transformed into several types of geomagnetic measures. The measures most typically used in psi research are the ap and the aa indices, the former being a three-hourly and the latter a daily measure of the mean change in the global GMF. The Ap (not to be confused with the ap measures) is also a daily measure very similar to the aa indices but is a result of measurements taken from thirteen measuring stations rather than just two, which is what the aa uses. As the Ap uses measurements from 13 monitoring stations rather than just the two, it was felt to provide a better overall global measure. This analysis will make use of both the Ap and ap values, providing a look at both the daily average (Ap), and the 3-hourly (ap) periods, for each ganzfeld session. The Ap and ap values are both expressed in nanoTesla (nano- means "1,000,000,000th of").

In order to examine the relationship between variations in geomagnetic activity and ESP performance within the PRL population, we retrieved geomagnetic indices for each day on which a ganzfeld session was conducted, from November, 1982 to July 1989. The analysis we report here is conducted on the entire database of 354 participants, and any missing values are noted where appropriate.

As the global indices (Ap and ap) are derived from quantized variables, their distribution is irregular and therefore a nonparametric correlation (Spearman's) was used to avoid assumption of normal distribution of geomagnetic field values. The present analysis uses the rank assigned to the actual target (i.e. 1-4) as the primary data point per session, and is thus comparable to results from similar studies. No significance difference between rank and either of the two values was found. The relationship (i.e. psi hitting and low geomagnetic activity) between the participants' ganzfeld target rankings (ESP rank) and the Ap indices was nonsignificant at rho = -.041, as was the relationship with the ap values, rho = -.040. There are four missing values for the ap indices due to the unavailability of a reliable time record for these sessions. The graphs shown above depict the distribution of values (Graph 1 = Ap, Graph 2 = ap), by rank.

Discussion

This report was intended to inform current on-going ganzfeld research by making use of a large, successful data pool. Undoubtedly some of these results do not represent real effects, and are due to the examination of so many facets of this dataset by various researchers. However, even if we corrected for multiple analyses we would be left with some interesting patterns. It should be the task of future researchers to determine which ones are real and which are simply due to chance variation in the PRL database.

In the sex pairing section, it was noted that same-sex pairings, particularly in that of the female experimenter data, showed a tendency to be the more successful pairing. The pattern of mixed-sex pairings doing better on tasks than pairs made up of same-sex pairings is one also found in social psychology (de Angelis, 1987). Hoffman (1965) concluded on the basis of a review of his work with problem-solving tasks, that mixed-sex pairs are more effective than same-sex ones. The reproduction of such a pattern in ganzfeld research serves to illustrate the point that the type of phenomena we study also conforms to the types of patterns found in similar, more conventionally accepted research. In the ganzfeld situation, it may be that male participants feel more constrained, defensive, or uncomfortable disclosing their imagery for a female researcher when their senders (who can also hear their mentation), are also male. The stronger effect size for female/female pairings in the male experimenters' data (and, thus, in the overall data), may be informed by examining the interactions of primarily young, single men working with young, primarily single, women. This type of social interaction may more account for the stronger effect than psi alone would. It is interesting to note that the study by Rumerick et al (1977) on the effects of experimenter sex in the behavioral sciences seemed to indicate that of more importance than the sex of the experimenter were characteristics and personal interactions. It may be informative for future ganzfeld research to include some assessment of the differences between social gender and genetic gender as well. This would allow the assessment of social roles in sex interactions in psi testing, allowing us a deeper understanding of the part genetic sex differences may play in successful ganzfeld studies. In addition, it is felt that the mentation from such studies would lend themselves well to discourse analysis to examine closer the relationship between social setting and sex interactions.

One of the lessons to be learned from the analyses in this paper is that it is not a good idea to combine results for two variables over a third categorical variable, without first checking to see if there might be differing relationships. For instance, we found that the most successful pairing of the sender and receiver teams depended on whether the experimenter happened to be male or female. By comparing Figures 1 and 3 with Figure 4, you can see that readers would have been seriously misled if we had offered only Figure 4 and the accompanying discussion, instead of including the breakdown by the sex of experimenter.

Because the hit rates were so much lower for static targets than for dynamic ones, it makes sense to examine the relationship between performance (hit or miss) and other factors separately for each of the two types of target. We have done so in this paper. We found that the receiver's relationship to the sender was important for the static targets, but not for the dynamic ones. In contrast, extroverts and introverts did about equally well for static targets, but extroverts performed much better than introverts with dynamic targets. Finally, highly competitive people had many more hits than their less competitive counterparts despite the target type. The actual hit rates are very different though, illustrating the need to examine variables such as these separately for the two target types.

In terms of the geomagnetic field, there have been many studies whose results seem to indicate that enhanced ESP is associated with periods of low geomagnetic field (GMF) activity. For example, Persinger and Krippner (1989) reported that higher scoring for dream ESP experiments tended to occur on days of low GMF activity, relative to the surrounding days, as did Tart (1988) in his study of GESP. However, this was not the case for the PRL database. Our analysis found no correlation between psi hitting and low geomagnetic activity. There are many factors that could account for this, one of which is the physical environment particular to the place where the sessions took place. The room in which the receiver resided throughout the session was heavily shielded, both electrically and acoustically, and this may have contributed to a lessening of the geomagnetic fields influence. Additionally, in spite of past research that has suggested magnetic fields could affect human physiology, May and Hubbard (1986) have argued that magnetic fields as weak as the geomagnetic field could not have an effect on human physiology, and in fact would most likely be swamped out by the stronger local fields caused by electrical appliances and such. Such an effect could account for the null relationship seen here. In addition, the global indices are positively correlated with several other factors (for example, see Rajaram and Mitra, 1981; Randall, 1990), and it may be that one of these is the mitigating factor for psi facilitation and not the geomagnetic field itself.

It is obvious that further research by other ganzfeld researchers is needed in the areas covered in this report to confirm and explore the issues raised by these findings.

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Differential Brain Responses to Targets and Nontargets in a Precognitive Forced-Choice Task

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Abstract

Event-related brain potentials (ERPs) were recorded from 22 subjects performing a forced-choice guessing task which was part of a larger study of pathological gambling. On each trial, ERPs were elicited by four, sequentially-presented, graphic images. After the last stimulus was delivered, subjects guessed which of the four images would later be randomly selected as the target for that trial. On the basis of two previous studies, we hypothesized that the Late Negative Slow Wave (L-NSW; 400-500 ms post-stimulus) and the Early Negative Slow Wave (E-NSW; 150-400 ms) would have greater negative-going amplitude over five pre-specified sites for targets than for nontargets. The two ERP hypotheses were tested on the "non-wagering" trials. The first hypothesis was marginally confirmed ($p = .085$, one-tailed); the second was strongly confirmed ($p = .007$, one-tailed). The results were interpreted as evidence of unconscious or preconscious psi. That is, although differential brain responses to target and nontarget stimuli indicated that psi information was detected by the subjects, it did not appear to strongly influence conscious behavior, as indicated by nonsignificant, marginally below-chance, guessing accuracy. Importantly, these results represent a replication and confirmation of our earlier findings with a group of unselected (for psi) subjects.

Introduction

The physiological approach to parapsychology dates back over thirty years. A number of physiological measures of autonomic or central nervous system activity including the plethysmograph, the galvanic skin response, and the electroencephalograph (EEG), have been studied as possible indicators of psi (see Beloff, 1974, for review of earlier work). Several other studies have examined event-related brain potentials (ERPs) elicited by task stimuli in ESP experiments (for review, see Warren, McDonough & Don, 1992a). As noted by Beloff, if, as is widely held, psi is largely an unconscious process, such physiological responses have an apparent advantage over the typical verbal response in ESP experiments because they may circumvent the conscious, decision-making process.

ERPs, which are coincident with, and superimposed upon, the "spontaneous" EEG, are minute fluctuations in voltage recorded from the surface of the scalp in response to both sensory stimulation, and different types of cognitive activity. Because ERPs are usually smaller than, and often obscured by the on-going EEG activity, ERPs are typically observed by averaging the brain's response to numerous, repeated stimuli. Averaging has the effect of enhancing the ERP relative to the on-going EEG activity. The ERP, which is time-locked to

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