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Geomagnetism and the Edinburgh Automated Ganzfeld

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Abstract: This paper reports on analyses examining whether variations in geomagnetic activity and ESP performance within an automated ganzfeld system are related. These analyses used the results from a 97 trial ganzfeld-psi experiment with a creative population, designed to examine the role of the sender, and conducted by the Koestler Chair of Parapsychology at the University of Edinburgh using their automated free-response testing system. Results of this study were 32 hits in 97 trials, for a hit rate of 33% (exact binomial p = .047). All analyses in this report are one-tailed unless otherwise specified.

Geomagnetic parameters using the ap, F, Y, local 'ap', and local Y-ap values were correlated with participants' ganzfeld target rankings. The relationship between the ap indices and rank was significant at Spearman's *rho* = .212, $p <$ .05. The correlation for local ap and rank was non-significant, but strongly in the direction opposite to that predicted, *rho* = -.289. Correlations for rank and F values were non-significant at *rho* = -.063, and correlations for Y and local Y-ap values with rank were suggestive but non-significant at *rho* = .141 and -.146. Ranks were divided into two groups of being either a Hit (rank of 1), or No Hit (rank of 2, 3, or 4), and comparison using a Kolmogorov-Smirnov two-sample test of the two groups with the ap, F, Y, local 'ap' and local Y-ap indices yielded a significant difference only for the ap indices of the Hit and No Hit groups at p = .04. Results for the F value were p = .09 (two-tailed), and the Y, local 'ap' and local Y-ap were non-significant at p = .34, .10, and .33, respectively. Relevant characteristics of GMF activity and of the geomagnetic indices are discussed.

Introduction

Geomagnetism and psi

The Earth is surrounded by a magnetic field similar to that surrounding a common bar magnet. The intensity of this geomagnetic field (GMF) is constantly changing as the Earth is subjected to solar particles and other extraterrestrial influences. Such 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. It appears from past psi research that *change* in GMF has more often been correlated with psi than GMF *intensity*. GMF change has most typically been measured using the ap and the aa indices. The ap index is a measure of the maximum fluctuation within a *three-hourly* period, while the aa index is a *daily* measure of the mean change in the global GMF. Apart from using these typical indices, however, we felt it was important to collect data using additional measures of GMF intensity. Therefore we also used F, a measure of the absolute local field intensity, and Y, a measure of the East-West component. The ap, F and Y values are typically expressed in nanoTesla.

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Research into the relationship between the GMF and ESP over the last decade has produced an increasingly large body of evidence that suggests a relationship between psi performance and fluctuations in the GMF field (Arango & Persinger, 1988; Berger & Persinger, 1991; Haraldsson & Gissurarson, 1987; Lewicki, Schaut & Persinger, 1987; Persinger & Schaut, 1988; Persinger, 1985, 1987; Radin, McAlpine and Cunningham, 1993; Schaut & Persinger, 1985; Spottiswoode, 1993; Williams, Roe, Upchurch & Lawrence, 1994). This relationship has associated periods of relative quiescence in the GMF with enhanced psi perception. As Persinger (1989) provides a sizeable review of this evidence, it will not be covered here, and interested parties are also referred to Wilkinson and Gauld (1993) for further discussion on the same topic.

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 geomagnetic effects on GESP. Similar findings were reported by Makarec and Persinger (1987), for card guessing scores. Spottiswoode (1990), in his analysis of six free-response studies, found a significant negative correlation between trial scores and the GMF values of the three-hour periods in which the trials occurred. The Spottiswoode study also pointed out that this observed geomagnetic effect was absent from studies with no apparent overall ESP result.

Although the literature is consistent in suggesting a relationship between the GMF and psi performance, few studies have used a creative population. A previous evaluation by Radin *et al.* (1993), of a ganzfeld study at Edinburgh that used both a creative population as well as a normal one, demonstrated a non-significant negative correlation between psi success and GMF for the normal population, but a non-significant positive correlation for the creative population. In effect, the creative population was evidencing a higher hit rate during periods of high geomagnetic activity, which is a reversal of the normally found trend. Given that the correlations were non-significant, it may be that this particular trend was a chance occurrence.

GMF indices

This report examines the possible relationship of the GMF with the outcome of a recent ganzfeld-psi study at the University of Edinburgh that used a creative population of artists and musicians for participants. In spite of the prior non-significant finding by Radin *et al.* (1993), for a creative population, the amount of previous research indicating a positive correlation between a quiet GMF and psi success seemed to warrant the hypothesis that this creative population would produce psi hitting in the ganzfeld on days of low activity, as measured by the ap indices. In addition, a report by Williams *et al.* (1994), from a ganzfeld study utilising multiple senders, also looked, post hoc, at the absolute intensity of the GMF using local F values in addition to their planned analyses of global values. They found a small positive correlation (Spearman *rho* = .16) between low GMF intensity as measured by the local values and good ESP performance. Additionally, Spottiswoode (1993) was able to examine local values in relation to the reported global values for his site and found that the global index provided a reasonable measure of local short term field changes. It was expected, then, that the local indices would reflect a pattern similar to the global indices. Thus, in the present study, analyses using GMF parameters derived from a local survey station approximately forty miles away were included in addition to the typically used global indicators.

It would seem that the determination of the mechanism, or mechanisms, by which ESP occurs would greatly facilitate the understanding of psi, and provide a solid base from which to explore psi. In addition, an understanding of the mechanisms of ESP would enhance the possibility of eliciting more controlled psi. The first step in this

determination would be the identification of some measurable variable that is systematically associated with the occurrence of ESP. The relationship between the GMF and ESP success could play a vital role in this search for the first physical correlate of psi.

One of the problems with past studies looking at the psi-GMF topic is that there is no clear idea as to what mechanism(s) could account for this relationship. Broadly speaking, we feel the possibilities are: (1) that the ambient magnetic field somehow interacts with, or composes, the physical mechanism underlying psi; (2) that some third factor modulates both the GMF and psi; or, (3) that the ambient magnetic field has some direct effect on human physiology that directly or indirectly affects psi functioning. Because Persinger (1979), among others, has considered the first two possibilities in detail, this study explored the third option.

Although past research has suggested that magnetic fields could affect human physiology, Hubbard and May (1987) have argued that magnetic fields as weak as the GMF could have no effect, and would most likely be swamped out by the stronger local fields caused by electrical appliances and such. However, more recent and better quality research than that which Hubbard and May were able to review indicates that this is indeed a viable proposition. It has been demonstrated that with fields *weaker than* the GMF, the brain exhibits electrical activity at the frequency of the ambient field, but *only* if the frequencies correspond to those occurring naturally in the brain (Bell, Marino & Chesson, 1994). However, these induced effects are transient (e.g., see the review by Ross-Adey & Bawin, 1977).

With these findings in mind, it was assumed that if the psi-GMF relationship was due to a direct interaction with human physiology, it would be beneficial to look at the state of the GMF at the actual time of the ganzfeld session. Thus, it was expected that low local field values would show a significant correlation with psi hitting. For this analysis, the ap index was used to give three-hourly measures of the global field change and F values were used to give a measure of the intensity of the local field. F values were also used to calculate local 'ap' values (after Spottiswoode, 1993) to provide a measure of the change in the local GMF. It was hoped that this would give a clearer picture of what aspects of the GMF were linked to psi performance: the *global* state of the field as compared to the *local* conditions; and the relative *change* in the field as compared to the absolute *intensity* of the field.

A further speculative analysis was based on a study by Ganguly (1986). Ganguly found that artificially generated ultra-low frequency (ULF) electromagnetic waves (that include the vital frequencies found to interact with the human brain; Bell *et al.*, 1994) could be found only in the East-West component of the GMF, possibly due to unique physical conditions found in certain ionospheric regions. Because these waves were known to interact with the human brain, and might conceivably affect the acquisition of psi information in some way, it was decided to look for a relationship between psi-hitting and this East-West GMF component (termed Y). In this case, it would be expected that the higher the intensity of the Y component, the greater the magnitude of the physiological driving response. Because the dominant frequencies of the ULF waves centre around 7 Hz, corresponding to the alpha brain state thought to be psi conducive (Morris, Roll, Klein & Wheeler, 1972; Stanford & Palmer, 1975), it was decided to predict a positive correlation between global Y intensity and psi hitting. Additionally, values for local Y intensity, termed 'local Y-ap' were calculated, and a positive correlation with psi hitting predicted.

Thus, the primary hypothesis for this analysis was:

1. a negative correlation between global ap and psi hitting in the ganzfeld.

The secondary hypotheses were:

2. a negative correlation between local ap and psi hitting;

3. a positive correlation between Y values and psi hitting;

4. a positive correlation between local Y-ap values and psi hitting; and

5. no direction predicted for the correlation between F values and psi success.

In order to examine whether there might exist differences between those who obtained direct hits (rank of 1 to actual target), and those who did not (rank of 2, 3, or 4 to target), the receiver's rank scores were broken into two groups and the same predictions applied to each of the GMF values specified (global ap, F, Y, local 'ap' and local Y-ap).

Method

The ganzfeld study in this analysis was conducted in the automated ganzfeld facility at the Koestler Chair of Parapsychology at the University of Edinburgh. The study was designed to explore the role of the sender in the ganzfeld and was carried out by Robert Morris, Kathy Dalton, Deborah Delanoy, and Caroline Watt. The study population consisted of artistically or musically creative participants, because this population has evidenced a track record of success in the ganzfeld in past studies (Morris, Cunningham, McAlpine & Taylor, 1993; Schlitz & Honorton, 1992).

For complete details on the Sender / No Sender ganzfeld study used in this analyses, see Morris *et al.* (1995). For additional information on the security measures involved, as well as additional information on laboratory layout, see Dalton, Morris, Delanoy, Radin, Taylor & Wiseman (1994). The final outcome from each experimental session was the receiver's ranking of four possible video clips, one of which was the actual target, the other three video clips being decoys. The present analyses use the rank assigned to the actual target (i.e., 1 - 4) as the primary data point per session, thus making the data comparable to results from similar studies (e.g., Radin *et al.* 1993).

Analyses

This report focuses primarily on the relationship between geomagnetic parameters and the outcome of the ganzfeld sessions. Other detailed information on the study, such as correlations with personality factors, creativity, imagery, etc., are reported in Morris et al (1995).

Geomagnetic indices were retrieved for each day on which a ganzfeld session was conducted, from February 9 to June 17, 1994, after all sessions had been completed. The geomagnetic analysis was conducted specifically after all data was collected to avoid the possibility that knowledge of geomagnetic parameters during the experiment might bias experimenters' expectations of individual sessions, thus no experimenter was aware of the state of the GMF on any day on which a trial was held.

Because the global ap indices are derived from quantized variables, their distribution is irregular and therefore a nonparametric correlation (Spearman) was used to avoid assumption of normal distribution of GMF values. Spearman's *rho* was also used to correlate target rank with the total intensity of the local GMF (F), and with the East-West component of the total field intensity (Y). Local 'ap' values were calculated from F values (after Spottiswoode, 1993) to provide a measure of the change in flux locally, and this was also correlated with receiver's rank score. Additionally, receiver's rank scores were broken down into two groups of 'Hits' or 'No Hits' where a rank of 1 equalled 'Hit' and ranks of 2, 3, and 4 equalled 'No Hit'. To compensate for the presence of outliers in the data, a Kolmogorov-Smirnov two sample test was used to measure the difference between the two groups in relation to each of the GMF values specified (global ap, F, Y, local 'ap' and local Y-ap). This is an omnibus test for the equality of two

distributions, being a non-parametric equivalent of the *t*-test, that is typically used for distributions with unequal numbers. All analyses in this report are one-tailed unless otherwise specified.

Results

Ganzfeld Hit Rate

The study resulted in an overall hit rate of 32 hits out of 97 trials, which is just statistically significant (exact binomial p = .047), providing further evidence for ESP results with the automated ganzfeld procedure. Results were non-significantly above chance for all three conditions. For more details on these results, please see Morris et al (1995).

Geomagnetism

It should be noted that, when several hypotheses are tested, be they preplanned or not, it can be expected that about 1 in 20 will be significant by chance alone using the .05 level.

The predicted relationship (i.e., psi success and low global geomagnetic activity) between the participants' ganzfeld target rankings (ESP rank) and the global ap indices was significant at *rho* = .212, $p < .05$, as is shown in Table 1.

Table 1
Spearman correlation matrix for geomagnetic values and assigned ESP rank (N=96)

	ESP Rank
ap	.212*
F	-.063
Y	.141
local 'ap'	-.289
local Y-ap	-.146

In the above table, N = 96 due to missing values in the geomagnetic data.
* significant at $p < .05$

Table 2
Results of Kolmogorov - Smirnov two sample test comparing geomagnetic values for Hit and No Hit groups

Geomagnetic Measure	**Maximum Difference**	***p*** **(one-tailed)**
ap by Hit	.267	.041
F by Hit	.261	.096*
Y by Hit	.149	.345
local 'ap'	.203	.104
local Y-ap	.152	.332

* two-tailed value

Table 3
Descriptive statistics comparing GMF values for hitting and non-hitting groups

	Hitting			Non-Hitting		
Geomagnetic Measure	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
ap	18.8	16.8	32	27.2	25.4	65
F	49187.6	103.4	32	49158.4	21.2	65
Y	1865.9	44.3	32	1870.5	40.5	65
local 'ap'	16.7	10.2	31*	16.4	11.3	64*
local Y-ap	18.5	11.8	31*	17.3	11.4	63*

* Missing value(s) due to unavailability of F value from survey station for full three hour period.

The correlation between rank and local 'ap' was non-significant, but strongly in the direction opposite to that predicted, *rho* = -.289. Had this direction been predicted, it would have been significant at the $p < .01$ level, and may indicate that a high level of local GMF activity was correlated with psi hitting. It should be noted here that unlike Spottiswoode (1993), we did not find the expected correlation of local ap with the global ap values, *rho* = .049. The correlation between ESP rank and F was non-significant (*rho* = -.063), as was the correlation between ESP rank and Y (*rho* = .141), and ESP rank and the local Y-ap (*rho* = -.146).

Ranks were then divided into two groups of either a Hit (rank of 1), or No Hit (rank of 2, 3, or 4). Comparison using the Kolmogorov-Smirnov two sample test (see Table 2) for the two groups with the ap, F, Y, local 'ap' and local Y-ap indices yielded a significant difference for the ap indices at $p = .04$, indicating that the distribution of the ap index was stochastically larger for the Hit group. Results for the F value were non-significant at $p = .09$, two tailed, as no direction had been specified in advance. The Y, local 'ap' and local Y-ap were non-significant at $p = .34$, .10, and .33, respectively. Table 3 gives the values from which the above results were derived, for completeness.

Discussion

The results of the present analysis replicate and extend the conclusions of other analyses in finding a significant relationship between the GMF and ESP success on days of low global geomagnetic activity ($p = .05$). Although previous work by Radin *et al.* (1993) had found a non-significant negative correlation between the GMF and the scores of a creative population in the ganzfeld at the University of Edinburgh, our study replicated the type of GMF relationship typically found with ESP success, that of a significant positive correlation. These results are similar to those of Persinger & Krippner (1989), who found a significant result of $p = .04$ for the aa values during the 24-hour period in which the strongest telepathy for dream ESP experiments occurred. In order to better understand our results, let us look at each of them and their implications in turn.

Intensity

Because neither F nor Y showed any significant correlation with psi rankings, it would appear that the absolute intensity of the GMF is not an important variable in determining successful psi functioning. However, Y does show a small correlation in the predicted direction (*rho* = .141). Al-

though no direction was predicted for the F value, a significant *one*-tailed F value (p = .04) for our Hit group is interesting to note, and may indicate that psi works best on days having some particular combination of intensity and flux.

Change

Because the ESP ranking showed a significant positive correlation with the global ap but a negative correlation with the local 'ap', it seems that the relationship between psi and the GMF is less straightforward than we supposed. Possibly the consistently found global correlation reflects the presence of a common factor between the GMF and psi, whereas the local correlation found here indicates a more direct interaction. In addition, because we also did not find a correlation between local and global values, this questions the assumption that the ap indices are always a good indicator of local values.

Y values

The lack of any significant correlation between the Y values and psi ranking could be due to one of four reasons: 1) the vital frequencies do not naturally occur more in the East-West direction than in the North-South or vertical directions and this finding was an artefact of Ganguly's (1986) experiment; 2) there is a further modulating factor that we have overlooked (e.g., driven brain state *plus* other environmental or psychological variable); 3) that absolute intensity is less important than the rate of change; or, 4) that there is no relationship at all.

In addition, the three-hourly values used in this study showed a comparable correlation to past studies using mean daily values. Although the significance of this pattern is not clear, it would seem to indicate that the continued examination of the state of the GMF near to the time of the actual psi session may be justified for future research.

It was also interesting to note that our local flux values showed a correlation in the same direction as that found by Radin *et al.* (1993), also for a creative population, whereas our global ones did not. A re-examination of Radin's data comparing actual ap and local 'ap' values to the estimated values (Planetary A-Index, or PAI values) he used could possibly help clarify these findings and help determine whether individual differences do indeed have such a strong effect on psi functioning.

An unexpected result of the present analysis was the significant value for the local 'ap' in a direction opposite to that predicted (*rho* = -.289). Had this direction been predicted, it would have been significant at the $p < .01$ level, which may indicate that a high level of local GMF activity was correlated with psi hitting. Future researchers should bear this in mind when making further predictions about the relationship between psi success and the local 'ap'. It had been felt that the local flux values (local 'ap' and local Y-ap) would be a more sensitive measurement than the global ap, particularly in view of the fact that the recording agency — a monitoring station at Eskdalemuir — is approximately 40 miles from the University. This gives rise to several considerations. Because the global indices are correlated with several other factors it may be that one of these is the mitigating factor for psi facilitation, which could explain the discrepancy. Fluctuations in geomagnetic activity correlate to a greater or lesser extent with fluctuations in solar, climatic and tectonic factors, all of which may in turn have some effect upon physiological functioning. Previous research suggests that there exists a variety of physical effects thought to be correlated with GMF indices, such as convulsive seizure frequency (Rajaram & Mitra, 1981), psychiatric admission rates (Raps, Stoupel & Shimshoni, 1992), and plasma melatonin levels (Randall, 1990). All of these involve factors that could possibly produce the observed correlations between the GMF and the ESP results reported here. This could indicate the presence of a psi factor that is related to the presence and duration of geomagnetic activity within an optimal range, or possibly

suggests yet another factor that requires an optimal rate of change in geomagnetic activity within a specific time interval to facilitate psi.

Given that environmental conditions provide a potentially rich source of signals to the human organism (Campbell, 1967), then it is to be expected that psi experiences, both in and out of the laboratory, should (like other behaviours) be influenced by complex, subtle stimuli within the environment. Analyses conducted by Persinger (1987), Persinger & Schaut (1988), and Wilkinson & Gauld (1993) on spontaneous case materials have indicated that the reported psi experiences of day-to-day life also take place, to a significant degree, in times of low geomagnetic activity. This appears to be especially true in the case of reported telepathic experiences (Persinger, 1987). Possibly then, it is the day-to-day variations in this global phenomenon that would help explain the persistent variability in the display and accuracy of these experiences, both in daily life and in the laboratory. It is clear that the examination of the GMF and its potential to become the first measurable physical correlate of psi is far from complete, and further research is needed to evaluate this potential.

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Geomagnetisme en geautomatiseerd Ganzfeld-systeem in Edinburgh

Samenvatting: Dit artikel behandelt het verband tussen veranderingen in geomagnetische activiteit en de ESP-scores in een geautomatiseerde Ganzfeld-opzet. Daartoe werden de uitkomsten geanalyseerd van een Ganzfeld-experiment van 97 sessies met creatieve proefpersonen, opgezet om