GEOMAGNETIC ACTIVITY AND PK ON A LOW AND HIGH TRIAL-RATE RNG

Dick J. Bierman
Chair of Parapsychology, University of Utrecht

Willem J. M. van Gelderen
University of Amsterdam

Abstract

Sixteen subjects did two sessions of 16 runs of micro-PK. There were 8 high trial-rate and 8 low trial-rate runs randomly mixed in one session. It was expected on theoretical grounds that the scoring rate on the low speed runs would exceed the scoring rates on the high speed runs. The two sessions, 'a' and 'b', were done about a week apart so that subjects were tested under two different conditions of geomagnetic activity. It was speculated that the difference in geomagnetic activity would correlate positively with the difference in average scoring on the PK-tasks.

Scoring rate on the low speed runs was 50.24 % versus 49.98 % on the high speed runs (t= 0.39; n.s.) with only marginally significant scoring on the slow runs in the first session (t=+1.8, df=15; p<0.05).

The correlation between geomagnetic activity and PK scores was -0.19 (N=64; p=0.13; n.s.). The correlation between geomagnetic increase or decrease from session 'a' to 'b' and scoring increase or decrease was not significant either (r= -0.12, N=32; n.s.).

Unexpectedly, a secondary analysis showed that when subjects scored low on high speed runs they would score high on low speed runs and vice versa (r= -0.423; N=32; p<0.02). This effect was consistent over sessions and over gender. A third order interaction between gender, trial rate and session number was found (F= 6.08; df=1; p< 0.03). Both significant findings are discussed in terms of balancing of PK scoring within and between subjects.

Theoretical background and research questions

Informal analyses of the average effect size for several parapsychological paradigms seem to imply that the effect size increases with the amount of time that is invested in a trial. Also previous experiments with Random Number Generators (Schmidt, 1973 & Bierman and Houtkooper, 1975) suggested that the scoring rates in RNG-experiments decreased with increasing trial rate. At that time this effect was largely discussed in terms of efficiency (which trial rate would be optimal to produce significance within the shortest time). However rather than practical the current focus on this effect is theoretical: if the effect size per unit time is indeed a constant then this gives a clear constraint to potential theoretical frameworks.

The first research-question is therefore if we can replicate the earlier findings with regard to the increase in psi effect size with decreasing trial rate.

Several authors have found evidence that GESP is negatively correlated with geomagnetic activity (Eg. Spottiswoode, 1990; Persinger, 1989). Some authors have speculated informally that PK would correlate *positively* with geomagnetic activity. In observational theories all psi-phenomena are unified as retro-active PK on either externally or internally random systems. An inverse relation of geomagnetic activity with GESP and PK would disfavour the observational theoretical framework.

The second research question is therefore to explore the relation between PK effect and the backgound geomagnetic activity.

Experimental procedure

Subjects

The 16 subjects were all volunteers and aquaintances of the experimenter (WvG). There were 9 males and 7 females with a mean age of 28.8 (male: 27.3 and female:30.7). Half of them were psychology students. The resulting majority had creative occupations. Five of the 16 reported no previous psi experience. Seven claimed a single type of experience (telepathy) and only 4 claimed more than 1 type of experience. None of the subjects practitioned mental arts. This sample could be characterized as somewhere between 'sheep' and 'goat'.

RNG and sampling algorithm

The RNG used in this experiment was a prototype second generation RNG derived from the original RIPP RNG (PRL report, 1983). It was tested before the experiment by running the same software as was used in the experiment but with no subject present. Also a few test runs at the maximum sample rate of 960 bytes per second were done. None of these tests yielded any significant deviation from chance expectation. After the experiment extensive testing on 1000 times the number of bits used in this experiment showed minor first order biases (< 0.003%) but these could not have influenced the over-all deviations found in the experiment because the experimental software used a counterbalancing algorithm for subsequent trials. At each trial the most significant bit of the byte was tested. For the first trial the rule was: if the bit is a '1' then it is a hit. On the second trial this rule is reversed and a '1' is counted as a miss. This procedure is repeated over all the consecutive trials..

```
x1:=XCharB()-127.5
dev:=-dev
IF(x1<0,R:=R-dev, R:=R+dev)
x1:=x0-R
x2:=x0+R
y1:=y0-R
y2:=y0+R
Circle(-1,x1,y1,x2,y2)
```

Table I
Code which samples a byte and gives feedback. The variable 'dev' is initialized as '1'.

Experimental runs

Each subject performed 16 runs per session. They did two sessions 'a' and 'b' about a week apart. Eight of the 16 runs were low trial-rate ('slow') and eight were high trial-rate ('fast') runs. Feedback to the subject came in the form of a black circle which grew or shrank depending on the random sample. The task of the subject was always to make the circle shrink. Due to the algorithm given above there was no need to counterbalance the target direction.

Experimental runs were done in the private setting of the subject's home using a portable computer. The experimenter (WvG, male) would explain the goal of the experiment, demonstrate it, and then leave the room until the subject had finished the 16 experimental runs. Each run was intiated by a button press.

Variables and hypotheses

Dependent variable

The unit of analyses is the z-score of a run. This is the normalized deviation of the number of samples in the target direction from the chance expectation.

Independent variables

1. Geomagnetic activity

The daily geomagnetic activity index (PAI), which is available via anonymous FTP from *xi.uleth.ca* in directory */pub/solar* was used as the index for geomagnetic activity. This daily average correlates highly for several stations over the globe and for subsequent 3 hour intervals.

2. Trial rate

The slow runs consisted out of 64 trials and the sampling rate was ~1 per second while in the fast runs (with 128 trials) the sampling rate was ~2 bytes per second. Thus both runs lasted about one minute and were psychologically nearly identical. Only one subject noticed the difference in trial rate.

Hypotheses

1. The mean z-score for slow runs will be larger than the mean z-score for fast runs.

2. The difference in run z-scores between the first and the second session correlates positively with the difference in geomagnetic activity. Remark that the geomagnetic activity during a session is assumed to be constant. Therefore the z-scores for the 8 fast and the 8 slow runs are pooled per session.

Results

Overall scoring rates and effect of trial rate

For a total of 512 runs or 49152 random events there was a deviation of +33 events from MCE in the target direction (50.08%). This effect was strongest for the low trial rate runs in the first session which resulted in marginally significant hitting (a t-test on the z-scores yielded t= +1.8, df= 15; p<0.05). The difference of 45 hits between slow and fast runs was far from significant.

	N	dev	%	z	t (df=15)	p of t
First session slow	8192	+68	50.8%	+ 1.5	+ 1.8	0.046
Second session slow	8192	-29	49.7%	-0.45	-0.53	0.7
Total slow	16384	+39	50.24%	+0.61		
First session fast	16384	-16	49.9%	-0.25	-0.3	0.61
Second session fast	16384	+10	50.06%	+0.22	+0.13	0.45
Total fast	32768	-6	49.98%	-0.07		
Total of all runs	49152	+33	50.08%	+0.30	0.36	0.36

Table II: over-all results split for session and trial-rate.

Geomagnetic effects

The correlation between mean run z-scores in the low and high trial-rate condition and the PAI measure for geomagnetic activity was -0.19 (N=64, p= 0.13). If anything, this would indicate that PK scoring is better when geomagnetic activity is low. However, in order to eliminate between subject variance, the planned test was to correlate the difference between the scores in the first session and the second session (dz) with the difference between the geomagnetic activity (dPAI). The correlation turns out to be -0.12 (N=32; n.s.). A regression plot is given in fig.1.

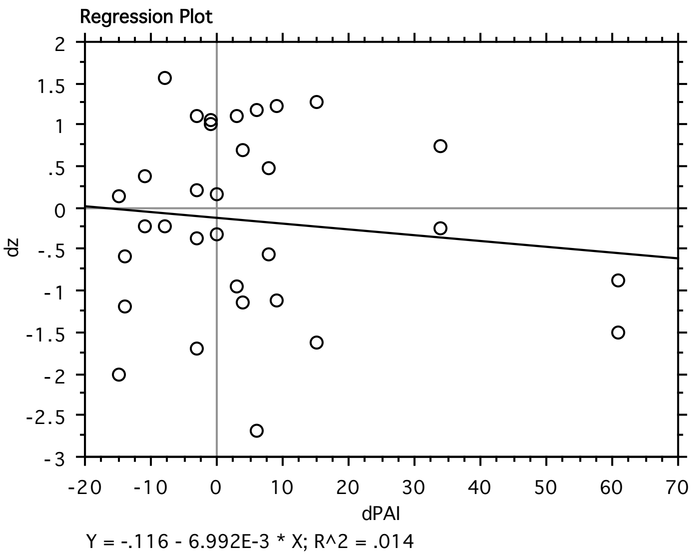

Fig. 1: Regression plot of dz versus dPAI

Post Hoc analyses

Gender and session number

Table III gives the t-values of the mean run z-scores split for trial-rate, gender, and session number.

	SLOW		FAST	
	Female	Male	Female	Male
Session A	+1.7	+0.47	+1.12	-1.4
Session B	+1.23	-0.70	-0.58	+1.08
pooled over session	+1.75	-0.41	-0.014	-0.082
TOTAL	+0.58		-0.07	

Table III: t- values split for trial-rate condition, gender and, session.

It can be seen that most of the positive scoring in the slow runs is due to the female subjects.

An analysis of variance was done on the mean run z-scores with gender as between-subject factor and session number and trial-rate condition as within-subject factors. This analysis yielded a significant third-order interaction of trial-rate * session number * gender.

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
gender	1	1.05	1.05	2.36	.1470
Subject(Group)	14	6.26	.45		
trialrate	1	.36	.36	.25	.6242
trialrate * gender	1	.95	.95	.67	.4260
trialrate * Subject(Group)	14	19.82	1.42		
sessionnr	1	.72	.72	.90	.3596
sessionnr * gender	1	.01	.01	.01	.9071
sessionnr * Subject(Group)	14	11.23	.80		
trialrate * sessionnr	1	.85	.85	.67	.4256
trialrate * sessionnr * gender	1	7.64	7.64	6.08	.0272
trialrate * sessionnr * Subje...	14	17.58	1.26		

Table IV: Results of 3-way ANOVA

This third-order interaction is graphically represented in fig. 2

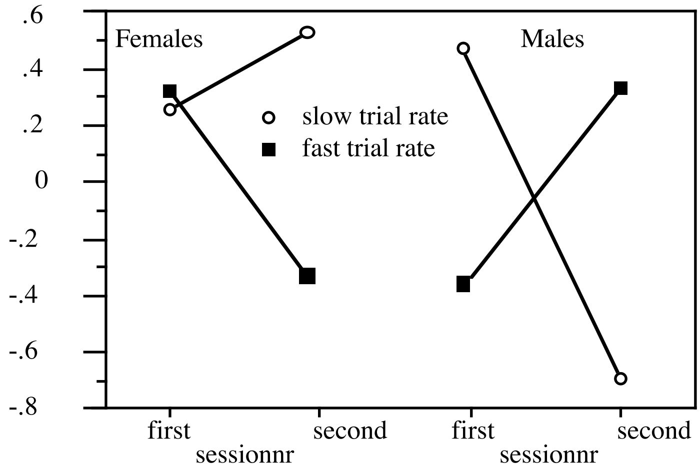

Fig.2

Mean run score for both sessions split for gender and trial rate

Reliability

To see if the 4 mean run scores that were calculated for each subject gave a reliable measure we calculated the correlation between the measures for each subject in the first and the second session (table IV):

Correlation Matrix

	slowa	fasta	slowb	fastb
slowa	1.000	-.484	-.114	-.239
fasta	-.484	1.000	.260	-.163
slowb	-.114	.260	1.000	-.397
fastb	-.239	-.163	-.397	1.000

16 observations were used in this computation.

Fisher's r to z

	Correlation	P-Value
slowa, fasta	-.484	.0566
slowa, slowb	-.114	.6787
slowa, fastb	-.239	.3792
fasta, slowb	.260	.3365
fasta, fastb	-.163	.5527
slowb, fastb	-.397	.1302

16 observations were used in this computation.

Table IV

Correlation between fast and slow mean run scores in first and second session

As can be seen from the table the correlations between first (a) and second session (b) are negligible, indicating that no reliable measurement was made.

Within-session balancing

To our surprise, however, the correlation between the slow and the fast runs within the session was consistently negative (r= -0.484 in the first and r=-0.397 in the second session). If one combines the sessions the correlation is r= -0.423 (N=32; p<0.02). A traditional interpretation would be that this indicates that the two measures for high and low trial rate runs do tap temporarily negatively related processes within the subject. This negative correlation is graphically represented in the regression plot of fig.3

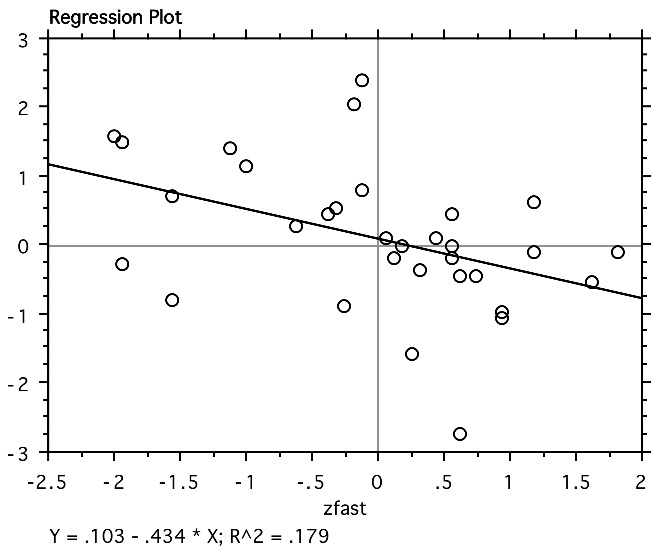

Fig.3

Regression plot of mean fast run score versus mean slow run score

The negative correlation is consistent over gender and over session (see table V)

	Female (N=7)	Male (N=9)
SESSION A	-0.576	-0.497
SESSION B	-0.476	-0.073

Table V

Correlation between mean slow speed and mean high speed run score split for gender and session

Discussion

Apart from the marginally significant scoring on the slow runs in the first session there appears to be no indication that psi was operational in this experiment. The experiment yielded no definite information with regard to the two major and theoretically relevant questions.

If anything, it appears that micro-PK is related to geomagnetic activity in the same way as GESP is related to this background variable. The value of the correlation found between mean run z-score and geomagnetic activitiy of -0.19 is in the same order of magnitude of the correlations reported between GESP and geomagnetic activity (generally about -0.20).

In a next experiment therefore the number of subjects should at least be doubled to have a reasonable chance to establish a real correlation.

The surprising finding of negative correlation between the mean run z-score on fast and slow runs within the sessions may of course be one of these spurious findings due to post-hoc (over) analysis. This analysis was triggered by the near mirror-image of fast & slow run scores in both sessions. In 1980 the first author argued (Bierman, 1980, *Negative reliability: the ignored rule*) that negative reliability was an ignored phenomena in psi-research. Researchers did often obscure the sudden reversals they found upon replication by framing effects as differential effects *without* giving any theoretical account for the direction (thus being forced to apply two-tailed testing). The second time around the*same* differential effect could then be claimed although the direction had reversed! In traditional science negative reliability of course does not exist.
A phenomenon that may be related to this negative reliability has recently been labeled 'the balancing effect' (Pallikiri-Viras, 1993). The theoretical notion behind this effect is that nature has a tendency to restore itself (that is to proper probability distributions) when brought out of balance due to (PK) interaction. This restoration may take the form of a damped oscillation within experiments, or of a decline across experiments (Bierman, 1993). The effect can be described as a transtemporal correlation. It is as if the history of some psi phenomenon 'influences' the replication effort. Transtemporal correlations may be caused by normal physical or psychological connections, like drifts in the RNG (physical) or boredom of the experimenters (psychological).
In the present experiment the physical explanation may be excluded because all scores are first order deviations from MCE and even if the raw bytes of the RNG drift, the sampling algorithm ensures that the scores do not drift.
The psychological interpretation may be excluded because the runs were randomly presented, so that no boredom effects or other temporal psychological changes can account for systematic relation between the slow and the fast runs.
Thus the present finding seems to represent a psi-induced transtemporal correlation. In contrast with the previous findings the balancing occurs within a subject.

The three way interaction where females decrease their performance on fast runs and increase their performance on slow runs, while males exhibit the reverse effect requires a model with a learning component, a gender component and a trial rate component. To our knowledge such a model does not exist. We doubt if such a model will (ever) be formulated and are inclined to interpret this finding either as chance result or as another indication of balancing effects. In this case the balancing is over subjects, between sessions and between trial rates.

References

Bierman, D.J., & Houtkooper, J.M. (1975). Exploratory PK-tests with a high speed random number generator. *European Journal of Parapsychology*, **1** (1), 3-14.

Bierman, D.J. (1981). Negative reliability, the ignored rule. In W.G. Roll, J. Beloff and J. McCallister (Ed.), *Research in Parapsychology 1980.* pp. 14-15. Metuchen, N.J.: The Scarecrow Press Inc..

Bierman, D.J. (1993). Patterns in elusiveness. In: *Extended abstracts of the Vth Euro-PA meeting*, sep. 24-26, 1993, Clos Notre Dame, France, pp.3-6. Avaialble by anonymous FTP from PSI_LINE.psy.uva.nl in directory GUESTS.

Pallikari-Viras, F. (1993). On the balancing effect hypothesis. *Proc. of the 36th annual convention of the PA*, pp. 378-389.

Persinger, M.A. (1989). Psi Phenomena and temporal lobe activity: The Geomagnetic factor. IN (L.A. Henkel & R.E. Berger, Eds) *Research in Parapsychology 1988*, pp. 121-155. Metuchen, N.J.: The Scarecrow Press Inc..

PRL-report 1983 (1983). Published by PRL, Princeton NJ. pp. 55-68.

Schmidt,H. (1973). PK tests with a high speed random number generator. , 37, p. 105.

Spottiswoode, S.J.P., (1990). Geomagnetic activity and Anomolous Cognition: A preliminary report of new evidence, *Subtle Energies*, V 1-1. pp 91-102.