collapsed across time of night within stage (e.g., early and late REM awakenings averaged to give one REM value), no significant differences were found among waking, REM, and Stage 2 trials for any PK task. Since the afternoon and nocturnal trials did not vary with the presumed underlying circadian temperature curve, it would appear that PK performance was not affected by the diurnal sleep/wake rhythm.

Control Trials (PKC). Data from the control trials were also analyzed to check that the RNG did not deviate from randomness even after several hours of continuous operation. The overall mean of these trials falls exactly at chance level, and an ANOVA finds no effect of gender, stage of sleep, or time of night (the latter would be expected if RNG bias developed over the course of the long experimental session). However, a marginally significant ($p = .052$) stage-by-time interaction surfaced. This is precisely the interaction predicted in Hypothesis 3, but to find it in the control data rather than in the experimental trials is disconcerting. Explanations relating to observer effect or RNG bias are rejected (for reasons that space does not permit detailing here). Since these trials were the last element in a very long and demanding procedure, the possibility remains that this interaction may be a "release-of-effort" effect on the experimenter's part.

Discussion

The results of this study do not support the predictions made at the outset. No systematic differences were found between REM and Stage 2 PK trials nor between the waking and sleep conditions. The time-of-night variable emerged only in the correlation with SSS ratings for the PKR trials and in interaction with the gender variable for the PKE trials. No direct evidence was found for a "release-of-effort" effect after overt trials with immediate feedback.

The major finding in this study was an interaction between stage of sleep and gender for the experimental trials only. This effect had not been predicted and is somewhat surprising, since gender often bears no relationship to psi performance. Due to the small sample size in the female group ($N = 10$) this finding should be replicated before being taken as definitive.

A major methodological problem in this experiment is that the PK trials were scheduled a considerable time after awakening from the preceding sleep stage, due to a conflict with other experimental procedures. By the time the PK trials took place, the subject had been awake and engaged in various cognitive tasks for approximately half an hour. For this reason it would be more correct to call the nocturnal trials "waking PK" rather than considering them as strongly influenced by the preceding stage of sleep. The failure to find a stage difference between REM and Stage 2 supports this view.

What is surprising is the failure to find differences between the afternoon control and the nocturnal PK trials, since some diurnal variation in performance was expected. (However, it may be noted that in this same experiment, performance on such cognitive tasks as digit span, anagrams, reaction time, and several perceptual tasks also did not differ between daytime and nocturnal sessions; in this context the PK data are at least consistent with the pattern of performance on other tasks.)

In conclusion, this experiment attempted to study PK performance as a function of (presumably) powerful physiological variables of sleep stage and time of night. However, overall differences between REM and non-REM awakenings, or between early and late arousals, were not found for any measure. For methodological reasons this study cannot be regarded as a definitive test of these variables. Replication with PK as the primary focus of the experiment, with PK trials in closer proximity to the preceding sleep stage, would be required before any firm statement can be made.

BUILDING A PK TRAP: THE ADAPTIVE TRIAL SPEED METHOD

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Psi can be described as altering the output probabilities of a random number generator (RNG). It does not matter whether the RNG is electronic, mechanical, or a living system. This view is developed particularly in the observational theories. Most lucid among these is Schmidt's mathematical model of psi. The basic idea is that the output probability of an RNG is changed by its connection to a so-called psi source. Feedback is crucial.

Another view of psi within the area of altering probabilities has been expressed by Breederveld (Research Letter, Parapsychology Laboratory, University of Utrecht, 1976 [No. 7], 1-9). Psi has a tendency to cluster into successful and unsuccessful periods: psi can be seen as cyclical. Breederveld suggests, further, that this clustering is a reflection, in the outside world, of the internal psychological states of the observer.

Schmidt has discussed the possibility that the psi source fluctuates in strength. But the original observational theories of Walker and Schmidt have little to say about what observation is. Recently, however, Millar (RIP 1986, 107-108) has proposed the Quasi-Motor Model, which explicitly deals with the observer's psychology. Feedback to the psi source is preprocessed by part of

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the normal human information-processing system. The preprocessing "program" may bring the external world into congruence with the observer's internal world.

Within this general theoretical framework, a major project on cyclical psi has developed within our research unit. Breederveld first devised a method to trap periods of psi-hitting, based on a stopping strategy. In his hands, this initially gave very promising scores. Later experiments lend some support to the view that it is a method for obtaining extrachance scores. However, the results are not reliable and the efficiency is very low. If the period of the psi cycle were irregular and only sometimes greater than the duration of the experimental set, such deficiencies would be expected.

Jacobs next devised a novel procedure, the adaptive trial speed (ATS) method, to trap even relatively short periods of psi-hitting. The basic idea is that trial speed is increased after a hit and decreased after a miss. The intention is that the sample frequency locks in to the psi cycle: during periods of psi-hitting, more trials are performed than in missing periods. This should lead to extrachance scoring in PK experiments.

This paper deals with explorations of the effectiveness of Jacobs' ATS method. Our unorthodox policy is to use self-test experiments. In our view, the classical multisubject psi test is often dominated by experimenter psi: it is, thus, merely a disguised version of the self-test experiment. For security reasons, such a design is frowned upon by the Rhinean school. But if results look promising, more security-oriented work can follow. We report here the first 8 of a planned series of 12 experiments; 4 different subject/experimenters carried out 2 experiments each.

Procedure

A computer/RNG set-up was used. The RNGs are units from our standard noise-based series. Philips P2000 computers were employed. The program is in BASIC, with linked machine code routines. The standard experiment consists of 100 runs, each of 500 trials. A trial involves sampling the RNG, which produces 0 or 1 with equal probability; the number generated is displayed on a TV monitor. The 1 output is the target. After a hit (1), the time to the next trial is shortened by one step; a miss results in an inter-trial interval that is one step longer. There are 12 speed steps in the range 3 s to 100 ms. As a hedge against possible bias, the output of the RNG is inverted in a pseudorandomly chosen 50 of 100 runs. The results for each run are automatically recorded on digital tape for later analysis. Each subject/experimenter worked in his own home, at his convenience; on average, 5 to 10 runs, taking half an hour to an hour, were performed per day.

Results, Refinement, and Further Results

In the first experiment Jacobs obtained 303 hits above mean chance expectation (MCE) in 50,000 trials: $Z = 2.71$, $p < .003$. Michels achieved an almost identical significant score: 304 hits above MCE, $Z = 2.72$, $p < .003$. In contrast, the Millars obtained only chance scoring (for Millar $Z = -1.53$ and for Millar-De Bruyne $Z = -0.66$). In round 2, the Millars' null results were replicated (for Millar $Z = 1.30$ and for Millar-De Bruyne $Z = 1.44$).

For this work a fairly extensive assortment of separate control experiments were performed. These gave the system a clean bill of health; they were, however, time consuming. Consequently, at this point, a methodological refinement was introduced ("double tick" sampling). For every trial two random bits were taken in quick succession. One of these was used as the experimental (E) trial proper, while the other served as control (C). Which of the bits became E was determined, on the fly, by a pseudorandom series. E and C were thus identical except that only E trials were presented as feedback to the subject.

With this improvement, Jacobs and Michels each ran a second experiment. In this case Jacobs' results (and controls) were at chance level ($Z = 0.93$). But Michels again produced a significant outcome (319 hits above MCE, $Z = 2.85$, $p < .002$): the concurrent control trials were at chance ($Z = -0.30$).

Discussion and Conclusions

The subjects scored true to type. The enthusiastic originator of the ATS method, Jacobs, succeeded in his first experiment but obtained only chance scores in the second. The Millars tendered support for the binomial theorem. Michels (JSPR, 1987, 119-129) has recently reported a highly significant series of self-test PK experiments, based on a stopping strategy. Here he continued his unbroken run of virtuoso performances.

In the midst of such subject variability, is it possible to say anything about the effectiveness of the ATS method? Chance results were obtained by both Jacobs ($Z = 0.64$) and Michels ($Z = 0.24$) in separate experiments with fixed trial speed. However, it would be naive to put much weight on the results of this "same subjects" design; both sophisticated subject/experimenters had an investment in the superiority of the ATS method. Less direct but more satisfactory is the difference with previous work. Using Schmidt's psi quotient, Michels' previous highly successful experiments pale by comparison: the current work is about five times as efficient in the sense that only one-fifth of the number of days is needed to achieve the same significance. This affords some suggestion that the ATS method really works, at least for Michels.

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The ATS investigations have, as spin-offs, shed light on Michels' abilities. The work reported here shows that he is not limited to one restricted experimental procedure. In the current experiments, too, the timing of RNG sampling is determined automatically: there is no sample switch, as in the earlier experiments. Consequently, skilled timing taking advantage of hypothetical periods of local nonrandomness is ruled out as a viable explanation of Michels' success.

In Experiment 2, with built-in concurrent controls, Michels' scoring was restricted to E trials, while the unseen C trials were unaffected. This strongly suggests that the effect is due to PK à la observational theories.

In the separate control experiment run by Michels to match his first ATS experiment, it was noticed that the number of hits (50,000) is exactly MCE. This seemed too good to be true ($p < .008$ [post hoc]). The control (simulation) runs in Michels' previous work (JSPR, 1987, 119-129) were therefore examined: in each of the three simulations, the results were also suspiciously close to MCE. For Michels, then, it seems that a separate "control" experiment may be just another kind of PK test, in which the goal is to score as close as possible to MCE. Jahn et al. (RIP 1985, 9-13) have reported similar findings.

Continuing this line of thought, the striking correspondence between the first experiments of Jacobs and Michels was examined. Not only the total scores but also the time course were significantly alike. These observations suggest that Michels may have used his psi abilities to copy Jacobs' results. If so, Michels' PK is quite susceptible to suggestion.

These incidental findings about Michels' ability are a valuable addition to knowledge about this PK star. The ATS method will be explored further.

EVENT-RELATED BRAIN POTENTIALS AND A PHENOMENOLOGICAL MODEL OF PSI-CONDUCIVE STATES

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A high-scoring subject, Olaf Jonsson, identified three altered states of consciousness associated with psi. He termed these

Condition One, Condition Two, and Condition Three, the last being the prime state of psi. Through the process of participant-observation a description of these states was elaborated which was similar to Carl Jung's writings on the psychological aspects of medieval alchemy. Two experiments were performed to investigate the event-related brain potentials (ERPs) associated with this phenomenological model and an objective, clairvoyant task. The term ERP is here defined broadly as that transient brain electrical activity that occurs time locked to specific events--either related to external events, endogenous events, or overt motor behavior.

The purposes of this single-subject study were: first, to record brain-wave data from several increasingly psi-conducive altered states of consciousness (State Study), and a forced-choice, five-response clairvoyant task (Prediction Study); secondly, to perform analyses in the time and frequency domains to discriminate correct (RTE) from incorrect (WRO) guesses and the various states of consciousness; thirdly, to cross-validate predictive models on additional, independent RTE and WRO trials.

Elaboration of the altered states description was derived from participant-observation of a subject who had performed at above-chance levels in previous psi tasks (Warren and Don, RIP 1986, 56-61). The report by Warren and Don presented evidence that both time- and frequency-domain ERP data could be used to significantly discriminate RTE from WRO trials in a clairvoyant task. The present study continued the investigation of ERP effects and in addition also studied the subject's self-reported altered states of consciousness and the ERP relationship between altered states and clairvoyant performance.

In the first experiment (State Study), ERPs were recorded while the subject cycled repeatedly through these three states and a control condition (mental arithmetic). In the Prediction Study ERPs were recorded during a clairvoyant task. In both experiments ERPs were recorded over an 8000 msec interval prior to each subject response from 5 EEG scalp sites, one bipolar EOG montage (below and above the right eye), and one EMG montage. Electrodes were placed at Fz, C3, Pz, C4, and Oz scalp sites referred to linked ears using a forehead ground. Grass model 7P122 amplifiers with eight-second time constants were used in a Grass Model 78 polygraph. On the EMG channel only, the time constant was 0.2 sec. The one-half amplitude high frequency cut-off was set at 60 Hz on the EEG and EOG channels and 75 Hz on the EMG channel. A 60 Hz notch filter was used on the EEG amplifiers. The EEG, EOG, and EMG data and event channel were digitized at 125 samples/sec (8 msec per datum). A trial consisted of 8000 msec of data (1000 data points) per channel.

In the State Study the subject initiated the beginning of a new trial each time he entered a new Condition (in his subjective

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