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A Random Number Generator Experiment: The Origin of Decision Augmentation Theory

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Abstract: In 1979, the research team at SRI International conducted a single random number generator (RNG) experiment. The goal was to replicate and extend the findings from a substantial literature in several ways. Sequential analysis was used to provide a two-fold increase in statistical sensitivity; two fundamentally different physical random sources were used: β-decay of ^{147}Pm and electronic noise from a well-understood silicon noise diode. Substantial engineering effort isolated these sources from environmental effects, and a quantum mechanical model accurately described the known properties of the electronic noise diode. An a priori definition of a successful outcome was more stringent than in the usual study; two participants out of seven must produce independently significant evidence of an effect. Seven participants who were screened for PK ability from a population of 17 candidates took part in the formal study. Two produced independently significant results ($p \leq 0.021$ and $p \leq 0.039$, respectively). While these results were consistent with those in the micro-PK literature, we report definitive evidence of no PK effects at all. Rather, the result appears to arise because of informational psi on part of the participant.

Keywords: RNG; radioactive source; electronic source; sequential analysis; significant engineering details

Introduction

Occasionally reports appear of anomalous failures of electronic equipment that seem caused by the proximity of certain individuals. Of special interest is a class of phenomena involving perturbation of sensitive equipment isolated from human participants by distance or shielding. In certain of these instances the generation of such effects appears to be under volitional control of the individuals involved. This paper is a modified version — edited for journal publication — of a declassified final report to the sponsor (Missile Intelligence Agency) in 1980 of a study, which was carried out at SRI International.[2] Included in this paper are experiments in which a participant attempts to affect the random output of RNG devices which are derived from electronic noise or radioactive decay. This kind of an experiment has an investigative appeal because it involves no subjective interpretation; that is, the results are expressed in terms of well-understood statistical terminology (May & Hubbard, 1980; May, Humphrey, & Hubbard, 1980).

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[2] As the declassified SRI International reports — now published in the Star Gate Archives Volume 3 —have limited reach, we considered it appropriate to republish this crucial background paper for the understanding of decision augmentation theory (DAT), relevant for the understanding of micro-psychokinesis as an informational rather than a causal process.

The first such experiment of this type was published by Helmut Schmidt (1969). As of December 1979, there had been 47 other papers published, mostly in the literature on parapsychology. The list, taken from the final report, can be found in the Appendix. These experiments have two points in common:

- A truly random input device for the RNG.
- An individual with motivation and intent to arrange the statistics of the output of an RNG to differ from chance expectation during designated periods.

A representative experiment might proceed as follows. An RNG device, such as the noise associated with a solid-state diode, is used to create a random binary sequence. The accumulated number of ones in the sequence (i.e., the dependent variable) is displayed graphically to the participant as a form of visual feedback. In a successful trial, the participant can (under the PK hypothesis) enforce an excess number of ones. As in the case of biofeedback research, effects have been demonstrated even when little is known about the underlying mechanism.

We examined the body of literature spanning the 10 years from 1970 to 1979 (see Appendix Table A). In this survey, we only considered the RNG experiments published in the three major U.S. parapsychological journals: *Journal of the American Society for Psychical Research*, *Journal of Parapsychology*, and *Research in Parapsychology*. This survey, which represents the vast majority of the published RNG studies from 1970 to 1979, is summarized in Table 1.

Table 1
Early Survey of the RNG Literature

# of References	Year	# Experiments	# Significant
2	1970	3	3
3	1971	6	4
5	1972	22	12
2	1973	7	7
3	1974	14	7
6	1975	17	7
10	1976	43	12
9	1977	46	10
6	1978	28	7
2	1979	28	5
Total: 48		214	74

Forty-eight papers reported a total of 214 individual experiments, 74 of which claimed statistically significant results. Ignoring file drawer considerations, the chance likelihood of such an outcome is approximately 2×10^{-41}.

This impressive statistic must, however, be evaluated with respect to experimental equipment and protocols. All the studies surveyed could be considered incomplete in at least one of the following four areas:

1. No control tests were reported in more than 44 percent of the references. Of those that did, most did not check for temporal stability of the random sources during the course of the experiment.
2. There were insufficient details about the physics and construction parameters of the experimental apparatus to assess the possibility of environmental influences.
3. The raw data were not saved for later and independent analysis in virtually any of the experiments.
4. None of the experiments reported controlled and limited access to the experimental apparatus.

We believe that the serious implications for applications and for science necessitated the design and execution of an RNG experiment that was more complete with respect to the four points enumerated above.

A two-phase program was initiated to accomplish this objective. Phase I aimed to develop a reliable computer-based, noise-driven RNG system and to certify that the binary bit streams produced by the generator met a number of statistical criteria for randomness. During Phase II, seventeen personnel were screened to select seven individuals who participated in the formal portion of this Phase. The testing procedure and the results are described in detail below.

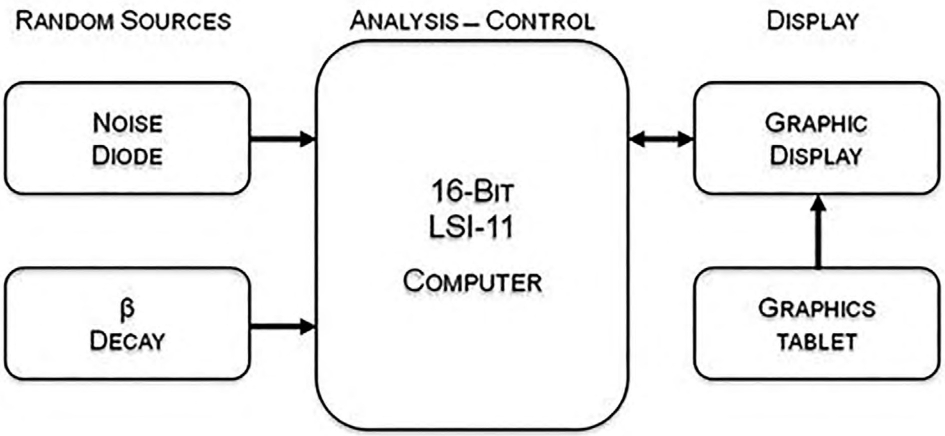
Random Number Generator System

A computer-based random number generator (RNG) was developed with special efforts made in two specific areas: First, extensive testing of the true random sources was carried out to study their response to environmental factors. Second, a variety of statistical tests were applied to the complete system to ensure that the output was truly random under experimental conditions. A detailed report on the Phase I hardware construction and system evaluation was submitted to the sponsor for review prior to the commencement of the study (May & Hubbard, 1980).

Hardware and Software

Figure 1 shows the overall hardware configuration, which consisted of three basic elements: (1) an isolated source of random electronic signals, (2) an analysis and control section, and (3) a graphics display unit. Following the techniques of learning theory, we used the graphics display unit to provide visual feedback of information about the current status of the binary sampling. We hypothesized that in this fashion the participant might learn to influence the sequence more readily.

Figure 1.
Block Diagram of the Computer Based RNG Hardware
(May, Humphrey, & Hubbard, 1980)

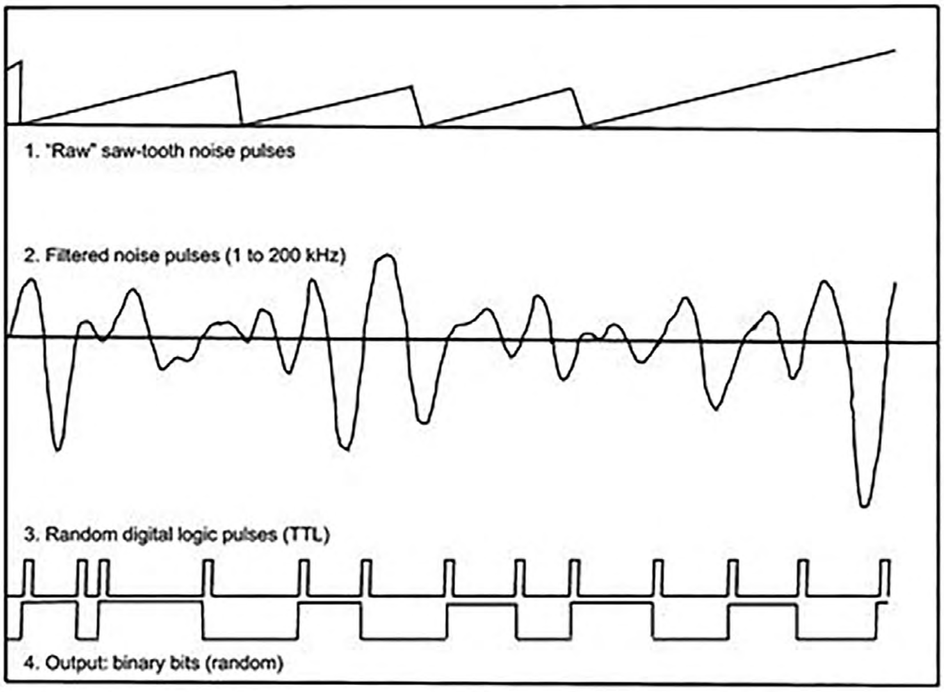


Random Sources

The random source elements consisted of a commercially available noise diode and a radioactive source with an appropriate radiation detector. A Texas Instruments MD-20 planar silicon noise diode was chosen for its large noise output (~500 μV/$\sqrt{Hz}$) and its well-described functional characteristics (Haitz, 1965, 1966).

Figure 2 shows the process by which random bits were generated from the noise diode source.

Figure 2.
Analogue to Digital Conversion.
(May, Humphrey, & Hubbard, 1980)



A random-amplitude 1-MHz saw-tooth voltage pulses from the diode were filtered by a 1 to 200 kHz band-pass filter (Figure 2.1). At each positive-going zero crossing of the filtered signal a TTL pulse was generated, giving a random digital signal (Figure 2.2). Finally, a divide-by-two circuit changed state at the rising edge of each TTL pulse, yielding a binary bit stream with probability of being in the logical one state of 0.5 (Figure 2.3). This bit stream was sampled and shifted into an 8-bit shift register at a 1-kHz rate, so that a random 8-bit number might be selected at intervals greater than 8 ms. The hardware included a double buffer, so as each 8-bit number was being transferred to the computer, the second buffer was being filled. This technique assured a continuous sampling at a 1 kHz rate.

^{147}Promethium (^{147}Pm) was selected as a radioactive source because it is nearly a 100-percent β-emitter (i.e., electrons) with essentially no competing decay modes. Detection of the electron energy continuum was accomplished using a well-understood and reliable ORTEC silicon surface-barrier detector.

A completely analogous process occurred with the β-decay source. The major distinction was that electrons of random energy arrived at a detector where they were converted into electrical signals of voltage proportional to the electron energy. A low-level discriminator generated a logic pulse whenever the voltage rose above a threshold corresponding to electron energy of 25 keV. From this point the signal processing was the same as described above in Figure 2.4.

Analysis and Control

The analysis and control portion of the system consisted of Digital Equipment LSI-11 microcomputer. The LSI-11 was programmed to sample one of the noise sources at a specified rate to obtain its random bits. A sequence of such samples was tested by the LSI-11 for an excess or lack of ones on a continuous basis, using a sequential analysis statistical technique (Fisz, 1973; Wald, 1973, p. 94).

Sequential analysis is roughly twice as efficient as traditional methods at reaching a pre-specified level of significance. Traditional methods require that the number of trials be specified in advance (i.e., independent variable) and the level of significance becomes the dependent variable; whereas, sequential analysis sets the level of significance in advance (i.e., the independent variable) and lets the number of trials be the dependent variable.

Before we are able to detect whether the random output of a binary generator has been influenced, we must *a priori* define criteria as to how much distortion of the null hypothesis distribution we require, and what statistical risks we are willing to accept for making an incorrect decision. To meet these criteria, sequential analysis demands the specification of four parameters to determine to which binomial distribution a particular data-sequence belongs; that is, a perturbed distribution or one that is not.

The four parameters are:

1. p_0: The fraction of ones expected in an undistorted distribution, 0.5 for a binary generator.
2. p_1: A threshold for the fraction of ones to define the mean of one of two distorted distributions.

3. p_2: A threshold for the fraction of ones to define the mean of the second distorted distribution.
4. α: The assigned acceptable probability for concluding that the random source is perturbed (i.e., p_1 distribution or greater or p_2 distribution or less) when it is not. This is the Type 1 error.
5. β: The assigned acceptable probability for concluding that the random source is unperturbed (i.e., p_0 distribution) when it is perturbed. This is the Type 2 error.

With these parameters, sequential analysis defines lines in a decision graph as follows: The lines in Figure 3 are defined as $p - p_0 = a + b \times t$, where for the positive lines, b is given by (Wald ,1973):

$$b = \frac{ln\left[\frac{1-p_0}{1-p_2}\right]}{ln\left[\frac{p_2}{p_0}\right] - ln\left[\frac{1-p_2}{1-p_0}\right]}$$

and for the negative line we use -*b* for the slope. For all lines, *t* is the sample count. The values for the intercepts, *a*, for the positive lines are given by:

$$a_+ = -\frac{ln\left[\frac{\beta}{1-\alpha}\right]}{ln\left[\frac{p_2}{p_0}\right] - ln\left[\frac{1-p_2}{1-p_0}\right]}$$

and for the negative lines, the *a's* are given by:

$$a_- = -\frac{ln\left[\frac{1-\beta}{\alpha}\right]}{ln\left[\frac{p_2}{p_0}\right] - ln\left[\frac{1-p_1}{1-p_0}\right]}$$

The value used in this experiment and the ones used to create Figure 3 are as follows: $\alpha = \beta = 0.05$, $p_1 = 0.52$, $p_2 = 0.48$, and $p_0 = 0.5$. Then b = 0.51, $a_+ = 36.79$ and $a_- = -36.79$. For the downward channel, slope = -b, and the a's are reversed.

For clarity display purposes we limited the maximum bits to 300; however, we used the equations above. Note we display excess hits on the vertical axis.

The Type 1 and Type 2 errors were chosen to provide an individually significant trial and the means of the two binomial distributions were characteristic of the hitting rates found in the literature.

The decision graph in Figure 3 works as follows: After the trial is initiated, we compute the on-going excess binary ones as the data collection continues. If the accumulated excess remains in the white regions of Figure 3, we continue to collect data. Should the excess exceed the upper line and enters Region II, the run stops and we conclude that we are sampling from a perturbed distribution with a mean of 0.52 or greater and the trial is significant with a *p*-value of 0.05. If the accumulated excess falls below the bottom most line in Figure 3 and enters Region III, the trial stops and we conclude that we are sampling from a perturbed distribution with a mean of 0.48 or less and the run is significant with a *p*-value of 0.05. This process is illustrated in Figure 4.

Figure 3.
Sequential analysis decision graph for the RNG experiment.
(May, Humphrey, & Hubbard, 1980)

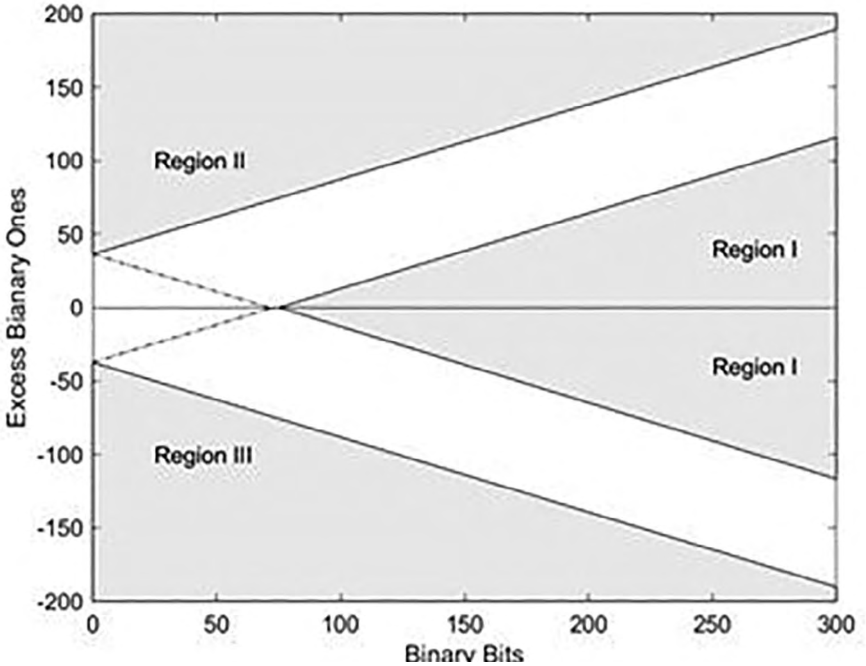
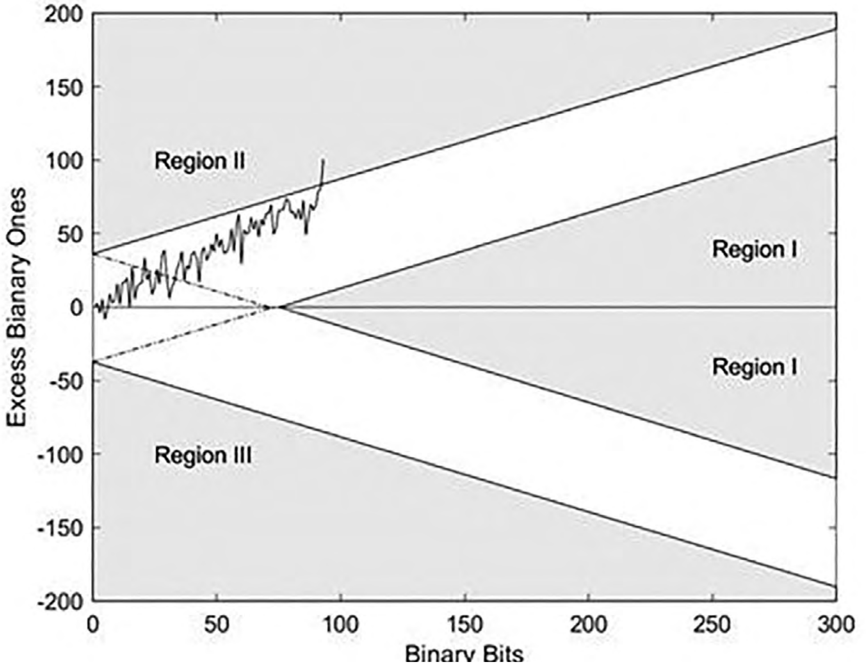


Figure 4.
An example of a single significant run.
(May, Humphrey, & Hubbard, 1980)



If, however, the accumulated excess exits into Region I, the trial ends and we conclude that we are sampling from a chance distribution with mean of 0.50. We make that decision with a *p*-value of 0.05.

Display

The computer-driven graphics display system consisted of two independent 19 inch color video monitors, a Grinnell display controller, and a Summagraphics 20 x 20 inch graphics tablet. Using these components, data from sequential sampling statistics, pulse height analysis, or any other output could be displayed. Figure 5 shows the experimental setup included the display.

Figure 5.
RNG System Setup. (May, 1982, p. 82).

Note: The random sources are contained in the two shoe-box like enclosures before the participant; the computer is located in the rack before her knees; and the display shows a successful run as determined by the sequential sampling algorithm.

System Testing

Noise diodes for use in this system were extensively tested for response to changes in temperature (-40 to +40 C), leakage current (40 to 200 μA), and other environmental factors such as a 6000-gauss dc magnetic field and low-intensity radioactive sources (^{241}Am, ^{60}Co, ^{147}Pm). We found that over the range examined for each factor the spectral noise density was flat within ±1 dB for the bandpass of the filter (1 to 200 kHz). Furthermore, the filtered noise followed a Gaussian distribution under all conditions tested as long as the leakage current was within 80 to 120 μA. We confirmed the manufacturer's specification for the dependency of the noise power-spectrum on temperature. This change was insignificant for variations of ±5 C near room temperature of 20 C.

The random emission of electrons from the β-decay of ^{147}Pm is independent of known external influences. The sensitive element, the surface barrier detector, was tested for changes in leakage current as a function of temperature. At the maximum temperature tested (~40 C) the noise contribution was caused by the increased current leakage and was eliminated completely with an appropriate low-level discriminator.

We assumed that the TTL logic circuitry of the major system elements (LSI-11, Grinnell controller, and the like) would continue to operate as specified by the vendor, so that extensive environmental testing of these components was not done. Any possible failures of these components would have been observed in the extensive control investigations described below.

System Isolation and Interference Protection

To prevent spurious signals from known external influences being incorporated into the random source output, numerous precautions were taken. Each random source was encased in a sealed 0.125-inch thick, soft iron box with radio frequency shielding to provide protection against mechanical, magnetic, or radio-frequency intrusion. Batteries supplied the electrical power to eliminate ac-line transients and 60-Hz noise. All data output to the LSI-11 occurred via optical transmission links to ensure complete electrical isolation. In addition, the noise diode was monitored continuously with a precision of ±0.2 C to determine any temperature changes.

Fail-safe circuits were included in both random sources so that the units would shut off automatically and require manual reset under the following circumstances:

- The battery supply dropped below a critical point (12 V).
- The electron detector leakage current rose above an acceptable level (2.0 μA).
- The diode current deviated from a narrowly defined current window.

System Certification Testing Results

A variety of fixed-length statistical tests were applied to 500,000 sample control runs of random numbers generated by the system described above. In addition, approximately 3×10^6 samples from each source were subjected to sequential analysis. No unexpected deviations from chance expectation were observed in any of these control tests, indicating that the system performed in accordance with design. Complete details of the hardware, computer software, testing procedures, and numerical results are detailed in May and Hubbard (1980).

Experiment Protocol

A complete experiment protocol was prepared and submitted to the client organization for approval in advance of the formal data-acquisition portion of Phase II.

Definitions

We begin the discussion of the Phase II formal test protocol by introducing a set of definitions of terms used in this section (Table 2).

Table 2

Definition of Terms

Term	Definition
Target Bit	The determined single bit of eight possible bits from one of the random sources to be used in the analysis.
Sample	The acquisition of eight binary bits from the RNG of which the fourth bit from the right (starting at zero) was defined as the target bit. The additional bits are to provide a local temporal history of the bit stream in which the target bit is imbedded.
Trial	A number of samples comprising a sequence that meet a set of statistical conditions in the sequential sampling that terminates the sequence.
Run	100 trials
Control Trial	A trial carried out automatically by the computer under the same conditions as the data acquisition session, but with no one present in the session area.
Sequential Analysis	The statistical procedure that provides a decision algorithm for terminating the trial.
Chance Distribution	A binomial distribution of binary digits (0, 1) with a mean probability of 0.5 for observing a one in the target bit and a variance of 0.25.
Perturbed Distribution	Binomial distributions with means greater than or equal to 0.52, or less than or equal to 0.48 (a two-tailed test).

Table 3 shows the timing intervals for a sample — one byte, trial, and run. It is important to note, that no bits in the binary sequence were lost for a single trial, and that data for each trial was a continuous record of bits collected in eight-bit samples. The average trial consisted of 3300 samples and lasted approximately 25 seconds. All bits from the source that were generated between trials were lost.

Table 3

Timing Intervals

Item	Timing Interval
Sample	8 ms
Trial	~25 s
Run	~3 months

A data-acquisition session was divided into three sections: Pre-session, Session, and Post-session:

- *Pre-session*: During the pre-session before the participant's arrival, the hardware was checked for proper functioning, and the set of variables characterizing the session (e.g., time of day, noise source) were entered into the system program. The variables chosen were those specifically determined for that participant during the pilot period. In addition, no less than five control trials were executed with no one present in the session area. These control trials were collected under the same environmental conditions as the session trials, except for the absence of putative human intervention. Once the control session was initiated, an automatic trial sequencer cycled through a sequence of trials, spaced apart by random time intervals Δt, $0 < \Delta t < 20$ s. This random spacing insured that the control trials simulated human interaction with the system as closely as possible.

- *Session*: To begin a session, the participant and a monitor entered the session room. The participant sat in front of the viewing monitor and controlled the start time of the individual trials by means of a start button on a cursor associated with the graphics tablet. This constituted the only form of physical interaction of the participant with the apparatus. The participant's task was to mentally cause either an excess number of ones or an excess number of zeros in the binary sequence. The session lasted no longer than 30 minutes. During the session, the participant received visual feedback for all trials, and auditory feedback (a bell) for trials that sequential analysis indicated belonged to one of the two distorted distributions.

- *Post-session*: The post-session consisted of a debriefing in which the participant discussed the experience. At the conclusion of the debriefing, there was an additional period during which no less than five more trials were conducted with no one present in the session area. Such post-session trials (not to be confused with control trials) were conducted specifically to investigate the claim that there might be a linger effect associated with the putative interaction. This linger effect might be compared to the well-understood physics concept of relaxation time. Post-session trials were recorded separately for later analysis. To allow for a putative possible linger effect, a minimum of one-hour separation between participants was enforced.

Controls

Aside from the pre-session control trials, a total of 1000 additional control trials were taken in sets of 100 or more for each of the participants. These trials were collected at random times on a 24-hour basis to establish the empirical sampling distribution throughout the formal testing period.

Test Requirements

The test requirements for a single trial were determined completely by the formulation of the sequential analysis theory described above. In that analysis a set of decision boundaries completely determines (within the bounds of the Type I and Type II errors specified) from which of the distributions (chance or distorted) a given sequence belongs. For a single trial to be successful, the sequence had to belong to a distorted distribution corresponding either to a mean ≥ 0.52 or ≤ 0.48, with a single-tailed confidence factor of 95 percent. The overall chance likelihood for making a decision in favor of a two-tailed distorted distribution on any given trial was 0.1.

Each participant was required to contribute 100 valid trials. To be valid, a trial had to meet certain pre-defined criteria.

The two random sources were equipped with appropriate hardware failsafe circuitry. Nonetheless, to account for possible hardware/software failures, we designated, in advance, the following certain conditions under which a trial would be rejected as invalid (i.e., not counted as part of the formal series):

- If the battery power supply dropped below a preset level, or various other hardware parameters exceeded their pre-specified operating ranges, the source output was inhibited. The system program detected this state and by software forced a "pass" condition for that trial. The trial just prior to system "shut down" was labeled "invalid" regardless of its particular statistic.
- As a further cross-check against possible source hardware difficulty, a trial was labeled "invalid" if the raw data contained five contiguous samples of identical data bytes. The probability of this occurring by chance alone is less than one part in 10^{12}. Because there was no prior evidence that such large-scale effects occur in RNG systems, we concluded that such a sequence of data bytes would most likely have resulted from momentary hardware failure. It is important to note that throughout all the formal trials in Phase II, none were declared as invalid.

Of the 100 valid trials, the number of sequences designated by the sequential analysis as being distorted were tallied by the computer. A simple binomial calculation shows that the probability of obtaining exactly 16 successful trials in 100 trials with the success probability (2-t) of 0.1 is 0.039, whereas for 15 successful trials the probability (2-t) is 0.065. The participant therefore had to produce 16 or more successful formal trials out of a total of 100 to have completed a significant run. As during a pilot period, the participant could choose to exercise a pass option before any given trial, in which case it was labeled as such in the computer record. Regardless of the outcome, a pass did not contribute to the formal series of 100 trials.

For the entire study to have significance, two or more of the seven participants chosen for the formal study were required to complete significant runs. The probability of obtaining two significant runs out of seven attempts by chance is ≤ 0.04. The probability of a single significant run is ≤ 0.26. We realize that this requirement is more stringent than the usual summing across all participants. In the Star Gate program, we were more interested in exceptional functioning than population averages.

Records

Two types of data recording were utilized during the formal test period: summary statistical information and the bit-by-bit recording of the raw data. For all trials (passes, pre-session and post-session controls, and the 1000 additional control trials for each participant), and a summary statistic was recorded on an eight-inch single floppy disk.

This data included the following:

- Date
- Time of day (to nearest second)
- Temperature of diode (if used)
- Source
- Pass indicator
- Accumulated number of trials
- Accumulated number of successful trials
- Number of samples in the given trial
- Number of ones in that trial
- Sequential analysis decision.

For all trials except the extra 1000 control trials, raw data was recorded on a second floppy disk. These included:

- All the data for each trial from the summary disk (redundancy check).
- All parameters of the sequential analysis used to analyze the trial in question.
- Two bytes of data for each sample, one byte for the random eight-bits acquired for that sample and one byte of count-rate information for secondary analysis (i.e., β-decay rate or the number of voltage zero crossings from the noise diode)
- Target bit position (i.e., bit number four) was constant for the whole study.

General Considerations

At no time did the participants have access to the generating hardware nor were they left unattended in the session area — a closed, classified area that was secured by combination and four-state cipher lock.

As with all experiments funded by the military, ours was required to meet minimal risk standards set by an Institutional Review Board (a.k.a., ethics, human uses committee). These requirements regarding human experimentation were in effect during the experiment. Since we were entering into a brand-new territory of research, safety of the participants was of primary concern for the IRB. Hence, no permission was granted to use participants who may possibly be pregnant, even unknowingly, as the experimental setup might jeopardize their well-being from some putative PK field during the effort periods.

Pilot Phase

Seventeen SRI International employees were chosen to take part in the pilot phase of this study. They were selected purely upon their own expressed interest in participating in such a study, rather than on any previous psi experience. During this and the final phase, the sample rate was fixed at 125 per second; but the participants were allowed to select their favorite time of day for their individual sessions, including their preferred experimenter, the source which seemed to "work" best, and the number of trials they would do at a single sitting.

Two general experimental parameters emerged from the pilot phase. First, it became rapidly apparent to the experimenters that an arbitrary limit of five trials/session seemed optimal. If the participant continued much beyond this limit, he became bored with the task and began to initiate each successive trial in a "mechanical" or by rote fashion.

Secondly, we felt that more interesting feedback displays might only serve to divert the participant's attention from the task; therefore, we decided not to design alternatives to the display of the sequential sampling decision lines. Neither of these two viewpoints were based on sufficient data to be statistically significant, but the pilot success rate of a number of participants indicated that these conditions should be included in the formal portion in Phase II.

Because the participants contributed varying numbers of trials, our selection criteria for the formal phase included not only the scoring rate, but also the participant's interest and availability for a three-month period. Table 4 shows the pilot results for each of the seven participants who were finally chosen for the formal experiment, and an asterisk indicates those participants who were scoring at a significant rate.

Table 4
Results of the Pilot Study

Participant	Source	Trials	Successes†
085	β-Decay	42	5
130	Diode	115	13
146	β-Decay	14	2
346	β-Decay	29	4
531*	β-Decay	74	16
758	Diode	45	5
827*	Diode	228	31

*Individually significant at p = 0.02 †Probability of a success of 0.10.

The combined score for all participants using the diode source approached significance (49 successes for 388 trials, $z = 2.61$, $p = 0.054$, ES = 0.133); the total for the β-decay source was significant (27 successes for 159 trials, $z = 3.62$, $p(2\text{-t}) \leq 4.4 \times 10^{-3}$, ES = 0.287). The difference between the two sources was analyzed by a student's t-test ($t(545) = 1.636$, $p = 0.513$, ES = 0.07). Thus, there was no meaningful difference between the two source types.

Global Control Runs

Global control runs were long sessions of trials generated without intentional influence on the apparatus in the absence of all personnel from the experiment environment. The sessions, which consisted of multiples of 100 trials each, were taken at all times of the day throughout the course of the formal experiment and were designed to monitor the long-term statistical behavior of the random sources. Such long runs average over small local deviations and give an accurate measure of the ideal distribution from which the samples are taken.

The protocol required 1000 trials for each participant. These runs were analyzed as 10 runs of 100 trials each. Overall in the two-tailed case, five runs were expected to show a significant deviation, and seven were observed. This result is not significant and confirms that the long-term parent distribution was the expected binomial.

Formal Phase

Each of the seven participants chosen for the formal phase contributed 100 trials over a 3-month period. Table 5 shows the results of the formal experiment as well as for the local controls and post-session trials.

Table 5
Formal Phase Results

Participant	Controls	Formal Results	Post Session
085	8/100	11	5/100
130	10/106	12	9/100
146	12/105	9	10/105
346	7/85	7	7/75
531	8/105	17*	8/105
758	9/95	16†	9/105
827	9/80	15	5/80
*$p(2\text{-t}) \leq 0.021$; †$p(2\text{-t}) \leq 0.039$			

Participants 085, 146, 346, and 531 used the radioactive source; participants 130, 758, and 827 preferred the noise diode. The formal phase results show that participants 531 and 758 produced 17 and 16 successes out of 100 trials, respectively. The odds that chance deviations alone produced this result are greater than 47:1 for 17 successes and greater than 25:1 for 16 (p = 0.021, ES = 0.303 and 0.039, ES = 0.275, respectively). Therefore, this study met the predefined criteria for being significant. *Post hoc*, we find that the total number of successes was 87 out of 700 trials (binomial p(2-t) = 0.01). Also we found, *post hoc*, that there was no significant difference between the two sources (t(698) = 1.45, p(2-t) = 0.146, ES = 0.047).

Discussion

This study was designed to determine the degree to which certain selected personnel were able to interact, by mental means alone, with sensitive electronic equipment. We met this predefined goal, significantly.

Yet, our results might possibly be accounted for by subtle, yet quite ordinary influences. As mentioned above, we noticed four major areas in which the survey of previous work was incomplete, which prevented us from properly assessing these influences in the studies in the survey. The possibility of such influence was one of the principle reasons for repeating the experiment. In our experiment we attended to those insufficiencies as follows:

- We performed detailed analyses of the physics associated with the random sources and determined their particular sensitivities to environmental parameters. We noted that the diode was mildly sensitive to temperature, and it was monitored throughout the experiment. (There were no significant correlations of small temperature fluctuations with statistical successes). A quantum mechanical model of the diode was developed and found to match direct measurement to within one percent error. This model enabled us, by Monte Carlo methods, to simulate temperature fluctuations and assess their influence upon the statistical output. We found that temperature changes of ±20.0 C did not affect the statistical, single bit probability of the binary sequence, which was the expected effect of the 200-kHz band pass filtering of the diode output. Likewise, large temperature changes in the radioactive source would have added electronic noise to the electron signal, but would not have affected the single bit probability. Considering the isolation precautions and the extensive random source testing, we concluded that the sources were stable against usual and in some cases (magnetic fields, for example), large environmental changes.

- We monitored the output from the sources with global and local control trials throughout the course of the three-month experiment. Because no long- or short-term statistical changes were observed, we concluded that both sources were stable with time.

- We saved a complete record of the sample-by-sample raw data for both the formal experiment effort as well as for the local control trials. These data were archived with the sponsor's organization.

- We conducted the entire experiment in a classified vault: at no time did the participants have unsupervised access to the room.

The experiment described in this paper is more complete with the addition of parameters described above. We have enumerated the individual results for local control, formal, and post-session runs in the previous section. Although the combined results for each of these three categories cannot be reported formally in terms of the protocol, they merit some discussion, nonetheless.

The combined result for the local control runs (63 successes for 676 trials) is not significant (binomial p(2-t) = 0.09), whereas the total across all participants for the formal experiment is. Five of the seven participants produced runs above chance expectation (ten successes), which contributed to the overall formal score of 87 successes out of 700 trials (binomial p(2-t) = 0.01). The odds that such a deviation would occur by chance alone are greater than 100:1. None of the formal trials were invalidated under the guidelines of the protocol.

The situation for the post-session runs is complex. None of these were individually significant. The binomial two-tailed p-value for participant 085 post session runs was 0.12. The overall total, for the post-session runs was low (53 successes for 670 trials, binomial p(2-t) = 0.076). In the protocol we noted that the post-session trials were used as a check on the claim of a linger effect: it had been noted in past experiments that after a significant deviation was observed during a participant's effort period, post-session trials taken just after an effort tended to deviate significantly as well. Usually, these trials would "decay" back to the expected value in a short period of time. We saw no evidence of such a correlation in our data, but we note here the significantly low overall result for the sake of completeness.

We conclude that we have observed an anomalous and, as yet, unexplained effect upon an electronic system, which cannot be accounted for easily by simple engineering considerations because:

- The magnitude of our results is commensurate with previous reported studies.
- Precautions and controls significantly exceeded any former experiments.

If we assume, then, that we have verified our initial hypothesis that an anomalous interactive phenomenon exists, we must then examine the possible mechanisms for this effect.

The first such potential mechanism, and that which is frequently mentioned in the data base, is some form of remote perturbation; that is, a physical change in a system that occurs without a participant's physical intervention. In this model, a participant through his volitional control literally "forces" a random source to change its behavior. This is at odds with currently accepted ideas of physics. However, Aharonov and Verdi (1980) describe that under specific conditions:

> … if one checks by continuous observation if a given quantum system evolves from some initial state, to some other final state, along a specific trajectory in Hilbert space, the result is always positive, whether or not the system would have done so on its own accord.

Aharonov and Verdi's reference to "continuous observation" is a critical point in their paper. They note that to enforce a change of state by continuous observation, the time between successive measurements is many orders of magnitude smaller than is presently possible for real measuring devices. Furthermore, it is a long way from a highly speculative consideration about the nature of a quantum system to a physical explanation for a given experiment.

A second possible mechanism, which was mentioned in Schmidt (1970a) entails some form of psychoenergetic data selection via precognition. In this mode of operation, the participant scans the unperturbed binary sequence ahead in time and selects the proper time to initiate the trial. This strategy enables him to take advantage of an unperturbed, yet significantly deviant subsequence and achieve a success for that trial. At first thought, this idea also seems inconsistent with current thinking in physics because it involves obtaining information about a future state of a random system with virtually an infinite number of possible future states available.

Many physicists have speculated upon the time-reversed information flow for quantum systems, but the most detailed discussion has been presented by Costa de Beauregard (1977, 1978). He showed, by using strict covariant formalism, that advanced probability waves can carry information from some future state of a system backward in time to the present. De Beauregard concludes:

> ... what would the phenomenology of advanced waves, decreasing probability, blind [masked] statistical retrodiction (sic), and information as organizing power, look like? Exactly to what parapsychologists call precognition and/or psychokinesis. Logically these phenomena *should* [emphasis original] show up, no less than thermo-dynamical progressing fluctuations — which indeed they are.

Within the physics community the concept of gaining information from future events may not be inconsistent with current ideas of quantum physics. Even if such physics speculations of de Beauregard should prove to be true, there are many unanswered questions: how does the participant “receive” such information and in what manner does this information reach the participant’s conscious awareness? We must emphasize here that de Beauregard’s hypothesis should not be regarded as proof of mechanism, but only as interesting speculation.

In our experiment, it was premature to attempt to determine what mechanism was involved. The objective simply entailed the verification of the existence of the phenomenon under nearly ideal conditions. Since this objective was met, future work in the area should focus attention in differentiating among the possible mechanisms.

Origin of Decision Augmentation Theory[3]

The main underlying purpose behind Decision Augmentation Theory is to provide a method to answer the pressing PK questions: are participants changing nature (i.e., causing bits in an RNG to be different as a result of volitional effort (PK) or are participants selecting (DAT) distorted data streams through the process of informational psi (IΨ), which are required for true binary sequences to mimic changes in the device. We define the state of the RNG as the parent distribution and what results from a measurement of the bit stream defines the sampling distribution. Then there are four possible interpretations of a putative PK RNG run:

1. Nothing is happening, indicating a mean chance expectation and an *unbiased* sampling from an *unperturbed* parent distribution

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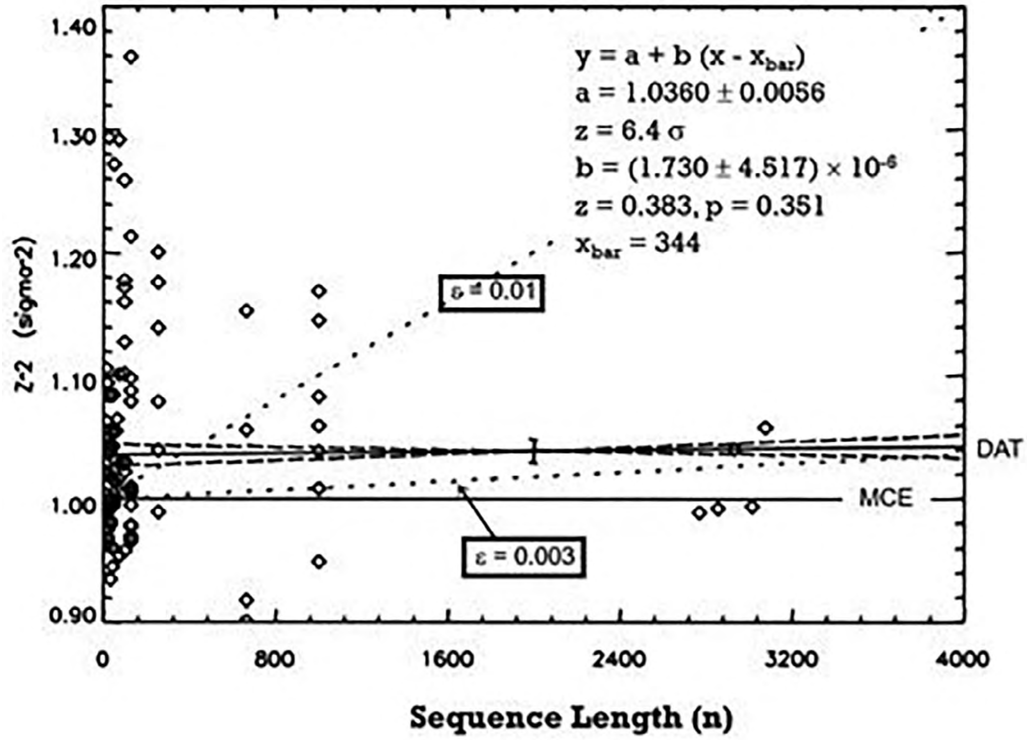
[3] This section of the paper is drawn from an earlier paper by the author: May, Utts, & Spottiswoode (1995a) with relevant permissions from the co-authors.

2. Nature is modified by an anomalous interaction, indicating a causal force-type interaction (PK), leading to an *unbiased* sampling from a *perturbed* parent distribution.
3. Nature is unchanged but the measurements are biased, where IΨ introduces a systematic bias in the measurement (DAT), leading to a *biased* sampling from an *unperturbed* parent distribution.
4. Nature is modified and the measurements are biased, where both PK and DAT are operating, leading to a *biased* sampling from a *perturbed* parent distribution.
5. Which of these four possibilities is the underlying process is answered in the mathematical formalism of DAT. As part of this study we analyzed 128 RNG studies using this formalism. Figure 6 shows the results.

Figure 6.

DAT Analysis of 128 RNG Studies. (May, Utts, & Spottiswoode, 1995a).



Note: The lines surrounding the DAT line are the 1σ error for the slope. This figure differs slightly from the reference in that we have add the ±1 σ slope error lines surrounding the DAT line.

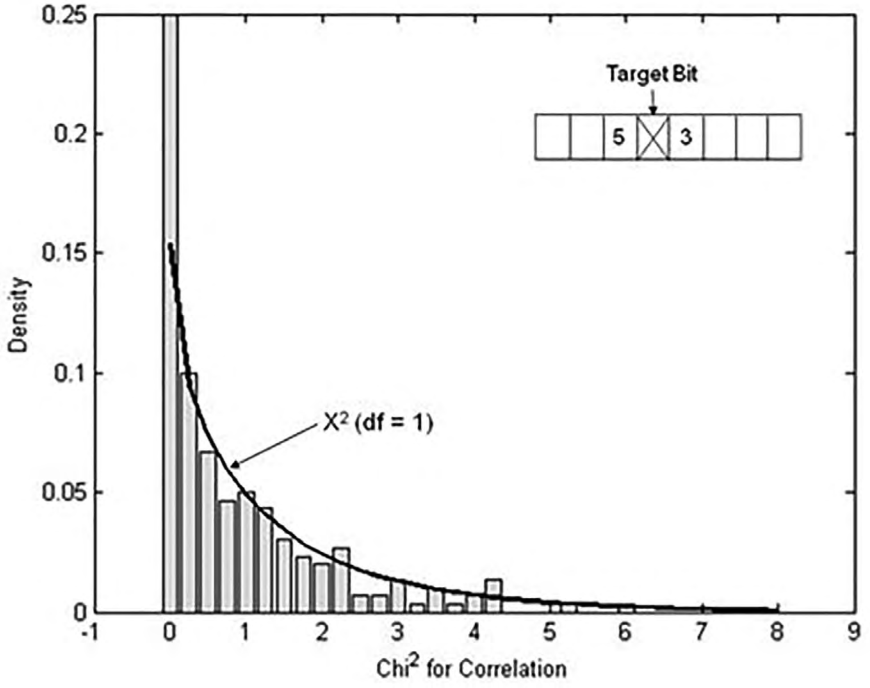
The x-axis is the number of binary bits from a single button press, and the y-axis is the squared *z*-score for the study. The DAT analysis computes the least squares best fit line to the data. The black line labeled MCE is the expected fit for that case. The two dotted lines are what would be the best fit line under two different putative PK effect sizes, shown in the black boxes. The horizontal black line is the actual least squares fit to the data with a slope = $(1.73 \pm 4.157) \times 10^{-6}$. It is labeled DAT because DAT predicts a zero for the slope. Note that the 1σ error in the slope surrounds zero in support of DAT. The error bar for the DAT best fit line indicates a *z*-score of 6.4 above chance. This analysis clearly rejects the PK hypothesis for the RNG data.

Additionally, this study presents several circumstantial arguments to question the force idea behind remote perturbation or psychokinesis. As we noted above, Schmidt (1970) was beginning to question the force concepts. These include:

- The quantum mechanical model we derived for the MD-20 diode, which was used as one of the sources in the experiment provides a complete description of that device. We were able to derive from first quantum mechanical principles the complete manufacturer's specification sheet for the MD-20 diode. This is primarily a testimony to the theory of quantum mechanics; however, for the experiment described here, it means we had a complete description of the diode that included all the known solid-state physics of the device. That meant we could adjust the parameters of the device to see what would be required to fit the observed data. Using the best techniques of global optimization available, no set of parameters could account for the statistically deviant outcome. This suggests that the physical device was not changed as a result of human focused attention.
- Of the four known forces in nature, the two sources of randomness involved the weak nuclear force and the electromagnetic force, the latter being 10^{11} times stronger. For a putative psi interaction to affect both sources, it requires some form of coupling to each of the highly divergent forces. Perhaps this is possible with the invention of some new physics, but it seems to us highly unlikely. In support of no interaction, we observed no significant difference between the effect sizes that was generated from the two radically different sources of random bits ($t(698) = 1.46$, $p(2\text{-}t) = 0.146$)

We tested this idea by looking at only the significant trials from the two successful participants. Keeping in mind that the target bit was bit number four, we computed the correlation between bits four and three, four and five, and three and five. Figure 7 shows the result.

Figure 7.
Correlation Analysis. (May, Utts, & Spottiswoode, 1995a).



The correlation result is the most compelling argument against an interaction of any type involved in the pre- and post-histories from the target bit. There is no known volitional activity that a human can accomplish in a duration of one millisecond — the time between adjacent bits in the data stream. In fact, it is also unlikely that human activity can be turned on and off within eight milliseconds — the time required to gather a single byte from the random sources. Minimally, we might expect that the neighboring bits to the target bit should be "forced" exactly as the target bit, or at least highly correlated with it. Typical CNS times for conscious and unconscious mental active range in the 200 to 500 milliseconds (Libet, 1985; Schelonka et al., 2017). The fastest CNS response we found was approximately 50 milliseconds (Chaumon and Tallon-Baudry, 2008), which is 50 times slower than the millisecond tick shown in Figure 7.

The histogram shows the x^2 for the various correlations among the bits. The smooth curve is the non-parametric theoretical expectation under the null hypothesis of no correlations among the bits (Mann–Whitney–Wilcoxon Test: $p = 0.193$). So, either there was no force of any type applied to the random sources or we must posit a new high-speed human physiological capacity to turn on and off again within one millisecond.

We think Schmidt (1969) was correct when he indicated that RNG data can be understood in selecting locally deviant subsequences from otherwise unperturbed sources of randomness. This was later developed into Decision Augmentation Theory (May, Utts, & Spottiswoode, 1995b).

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Appendix

Table A.

Random Number Generator Survey From 1970 to 1979. (May, Humphrey, and Hubbard, 1980, pp. 69-72).

Title/Author	Comments	Statistics*
1970		
PK experiments with animals as subjects (Schmidt, 1970b)	cat experiment	1.60×10^{-2}
PK experiments with animals as subjects (Schmidt, 1970b)	cockroach experiment	1.00×10^{-4}
A PK test with electronic equipment (Schmidt, 1970a)		1.00×10^{-3}
1971		
A PK experiment comparing meditating versus non-meditating subjects (Matas and Pantas, 1971)	Meditating / Nonmeditating	2.00×10^{-2} n.s.
PK scoring under preferred and nonpreferred conditions (Pantas, 1971)	Preferred condition / Nonpreferred condition	1.00×10^{-2} n.s.
Psi tests with psychologically equivalent conditions and internally different machines (Schmidt and Pantas, 1971)	Precognition	1.00×10^{-2}
Psi tests with psychologically equivalent conditions and internally different machines (Schmidt and Pantas, 1971)	Psychokinesis/ precognition	1.70×10^{-2}
PK conditioning (Camstra, 1972)	I. Auditory feedback (a) Subjects asked to concentrate	n.s.
	(b) Subjects asked not to concentrate	significant
	II. Enhanced feedback: auditory and visual	n.s.
1972		
PK performance with waking suggestions for muscle tension versus relaxation (Honorton and Barksdale, 1972)	I. Passive concentration/muscle tension	2.00×10^{-3}
	Active/tension	n.s.
	Passive/relaxation	n.s.

	Active/relaxation	n.s.
	II. Replication using individual subjects (not group PK)	
	Active/tension	n.s.
	Passive/relaxation	n.s.
	Active/relaxation	n.s.
	III. Replication using single subject Tension	5×10^{-5}
	Relaxation	5×10^{-4}
Confirmation of PK action on electronic equipment (André, 1972)	I. Experiment 1	
	Morning session	3×10^{-3}
	Afternoon Session	n.s.
	II. Experiment II: Morning Session Only (strong decline effects observed)	5×10^{-3}
Psi tests with internally different machines (Schmidt and Pantas, 1972)	I. Experiment 1: Groups	
	Precognition	1×10^{-2}
	PK	5×10^{-4}
	II. Experiment 2: single subject	
	Precognition	5×10^{-5}
	PK	5×10^{-3}
A subject's efforts towards voluntary control (Kelly and Kanthamani, 1972)	Four-button machine	1×10^{-9}
	Noise source (2 subjects combined)	5×10^{-3}
1973		
PK tests with a high speed RNG (Schmidt, 1973a)	Slow/visual	1×10^{-2}
	Slow/acoustical	1×10^{-2}
	Fast/visual	1×10^{-2}
	Fast/acoustical	1×10^{-2}
PK effects on random time intervals (Schmidt, 1973b)	Several subjects	2.6×10^{-5}
	One subject	1.45×10^{-4}
	Brine shrimp	1.37×10^{-3}

1974		
Psychokinetic influences on an electromechanical random number generator during evocation of "left-hemispheric" vs. right-hemispheric functioning (Andrew, 1974)	Right hemispheric tape	2×10^{-2}
	Left hemispheric tape	1.10×10^{-2}
Observation of subconscious PK effects with and without time displacement (Schmidt, 1974a)	Present time	1×10^{-3}
	Pre-recorded time	1×10^{-3}
	Pre-recorded control	n.s.
Comparison of PK action on two different random number generators (Schmidt, 1974b)	I. Five subjects/200 trials each	
	Simple generator	5.11×10^{-3}
	Complex generator	n.s.
	Simple generator "inactive"	n.s.
	II. Ten subjects/100 trials each	
	Simple generator	6.74×10^{-3}
	Complex generator	n.s.
	Simple generator "inactive"	n.s.
	III. Twenty subjects/50 trials each	
	Simple generator	3.57×10^{-2}
	Complex generator	n.s.
	Simple generator "inactive"	n.s.
1975		
PK experiment with repeated, time displaced feedback (Schmidt, 1975)	Present time	$5 \times 10^{-2**}$
	Prerecorded	$5 \times 10^{-4**}$
Volitional control in a PK task with auditory and visual feedback (Honorton and May, 1975)	High aim	$9 \times 10^{-3**}$
	Low aim	n.s.
A dynamic PK experiment with Ingo Swann (May and Honorton, 1975)	PSI FI	1.10×10^{-2}
A Preliminary PK experiment with a novel computer-linked high-speed random number generator (Millar and Broughton, 1975)	I. RNG 1: 1000/s	n.s.
	II. RNG 2: 100/s	n.s.
	III. RNG 3: 10/s	n.s.

	IV. RNG 4: 1/s	n.s.
Psychokinetic influences on random number generators during evocation of “analytic” versus “nonanalytic” modes of information processing (Braud, Smith, Andrew and Willis, 1975)	I. (see RIP , 1974, p. 58)	
	Physiology monitored/ Experienced monitor	
	Non-analytical mode	2.50×10^{-2}**
	Analytical mode	n.s.
	No physiology/naive monitor	
	Nonanalytical mode	n.s.
	Analytical mode	n.s.
Psychokinesis as psi-mediated instrumental response (Stanford, Zenhause, Taylor and Dwyer, 1975)	Experimenter 1: conscious PK	n.s.
	Experimenter 1: unconscious PK	5×10^{-2}
	Experimenter 2: conscious PK	1×10^{-2}
	PK Experimenter 2: unconscious	n.s.
1976		
A test of intentional versus unintentional PK (Millar and Mackenzie, 1976)	Intentional condition	n.s.
	Unintentional condition	n.s.
Effects of meditation and feedback on psychokinetic performance: A pilot study with an instructor of trancendental meditation (Honorton, 1976)	I. Premeditation feedback	
	High-aim	n.s.
	Low-aim	n.s.
	II. Meditation without feedback	
	Theta-alpha	n.s.
	Outside theta-alpha	n.s.
	III. Post-meditation feedback	2.40×10^{-2}
	High-aim	
Effects of meditation and feedback on PK performance: results of practitioners of ajapa yoga (Winnett and Honorton,1976)	I. Premeditation feedback	
	High-aim	n.s.
	Low-aim	5.00×10^{-3}
	II. Meditation without feedback (no physiology)	n.s.
	III. Post-meditation feedback	
	High-aim	n.s.
	Low-aim	n.s.

The performance of healers in PK tests with RNG feedback algorithms (Bierman and Wout, 1976)	Experiment 1: (RNGS used separately)	
	Group A: False Feedback	
	Fast RNG	n.s.
	Slow RNG	n.s.
	Group B: True Feedback	
	Fast RNG	n.s.
	Slow RNG	n.s.
	Experiment II: (RNGs used simultaneously)	
	Group A: False Feedback	
	Fast RNG	n.s.
	Slow RNG	n.s.
	Group B: True Feedback	
	Fast RNG	n.s.
	Slow RNG	n.s.
	Experiment II: (RNGs used separately)	
	Group A: False Feedback	
	Fast RNG	n.s.
	Slow RNG	n.s.
	Group B: True Feedback	
	Fast RNG	3.16×10^{-2}
	Slow RNG	3.16×10^{-2}
PK effects by a single subject on a binary random number generator based on electronic noise (Hill, 1976)	One subject	1.60×10^{-3}**
A PK experiment with a covert release-of-effort test (Broughton and Millar, 1976)	Overt trials	n.s.
	“Release-of-effort”	n.s.
Search for a relationship between brainwaves and PK performance (Schmidt and Terry, 1976)	A1pha/enhancement	1.93×10^{-3}
	Beta/enhancement	1.93×10^{-3}
	Alpha/suppression	n.s.
	Beta/suppression	n.s.

A covert PK test of a successful psi experimenter (Millar, 1976)	Altered x^2 values	n.s.
An investigation of the psi enhancement paradigm of Schmidt (Millar and Broughton, 1976)	Experimenter 1: Present time	n.s.
	Prerecorded	n.s.
	Experimenter 2: Present time	n.s.
	Prerecorded	n.s.
PK effects on prerecorded targets (Schmidt, 1976)	Experiment 1:	
	Present time	1.00×10^{-3}**
	Prerecorded	1.00×10^{-3}**
	Experimenter 2:	
	Present time	5.00×10^{-2}
	Prerecorded	5.00×10^{-3}
	Experimenter 3	
	Present time	5.00×10^{-2}
	“Easy” trials	n.s.
	“Difficult” trials	n.s.
1977		
Conscious and subconscious PK tests with prerecorded targets (Terry and Schmidt, 1977)	Total conscious	5.00×10^{-3}
	Total subconscious	n.s.
A PK investigation of the experimenter effect and its psi based component (Broughton, Millar, Beloff and Wilson, 1977)	Sixteen experimenters using prerecorded targets (reported as 16 different experiments)	n.s.
Psychokinetic effects upon a random event generator under conditions of limited feedback to volunteers and experimenter (Braud and Braud, 1977)	Experimenter trial-by-tria1 feedback	
	Subject/feedback	n.s.
	Subject/nonfeedback	5.00×10^{-2}
	Experimenter/global feedback Subject/nonfeedback	5.00×10^{-2}**
Computer controlled random number generator PK tests (Jungerman and Jungerman, 1977)	I. $p_0 = 1/2$	4.00×10^{-2}
	II. $p_0 = 1/8$	n.s.

A test of the Schmidt model's prediction concerning multiple feedback in a PK task (Davis and Morrison, 1977)	Direct	n.s.
	Delay one	n.s.
	Delay four	n.s.
Plant PK on an RNG and the experimenter effect (Edge, 1977)	I. Growth in darkness	
	Plants absent	n.s.
	Plants present	n.s.
	II. Plants light-starved	
	Plants absent	n.s.
	Plants present	n.s.
	III. Growth in darkness/addition of florescent light	
	Plants absent	n.s.
	Plants present	1.70×10^{-6}
	IV. Same as III above	
	Plants absent	n.s.
	Plants present	3.60×10^{-2}
Allobiofeedback: Immediate feedback for a psychokinetic influence upon another (Braud, 1977)	I. (Experimenter effecting subject GSR)	1.0×10^{-2}
	Effect on RNG with respect to experimenter feedback	
	A. Audible	n.s.
	B. Inaudible	$5.0 \times 10^{-3**}$
Electronic random number generator operation associated with EEG activity (Heseltine, 1977)	Experiment I	
	High tone	n.s.
	Low tone	1.50×10^{-2}
	Nonfeedback	
	Experiment II	
	Low tone	5.0×10^{-4}
	Nonfeedback	n.s.
A take-home test in PK with prerecorded targets (Schmidt, 1977)	I. Experiment 1: Prerecorded high tone and prerecorded low tone combined result	1.0×10^{-3}
	II. Experiment 2	
	Group/inspected	n.s.

	Group/not-inspected	n.s.
	Individual/inspected	n.s.
	Individual/not-inspected	n.s.
Electronic random generator operation and EEG activity: Further studies (Heseltine, 1978)	I. Series 3	
	Left hemisphere/feedback	2.0×10^{-2}
	Left hemisphere/no feedback	n.s.
	2. Series 4	
	Right hemisphere/feedback	n.s.
	Right hemisphere/no feedback	n.s.
	3. Series 5	
	Left hemisphere/feedback	n.s.
	Left hemisphere/no feedback	n.s.
Psi correlates of volition: A preliminary test of Eccles' "neurophysiological hypothesis" of mind-brain interaction (Honorton and Tremmel, 1978)	I. Experiment 1	
	Gated EEG/feedback	2.0×10^{-3}
	II. Experiment 2	
	Gated EEG/feedback	5.0×10^{-3}**
	Ungated EEG/feedback	n.s.
	Gated EEG/feedback	n.s.
	Gated EEG/feedback	n.s.
Search for psi fluctuations in a PK test with cockroaches (Schmidt, 1978a)	Algae	n.s.
	Yeast and chlorella	n.s.
	Wingless fruit flies	n.s.
	Cockroach replication	n.s.
Use of stroboscopic light as rewarding feedback in a PK test with prerecorded and momentarily-generated random events (Schmidt, 1978b)	I. Section 1	
	Prerecorded/ON	3.73×10^{-3}
	Prerecorded/OFF	n.s.
	II. Section 2	
	Real time/ON	1.93×10^{-3}
	Real time/OFF	n.s.
PK with immediate delayed and multiple feedback: A test of the Schmidt model's prediction	Direct	n.s.
	Delay one	n.s.

(Morrison and Davis, 1978)	Delay four	n.s.
Intentional observer influence upon measurements of a quantum mechanical system: A comparison of two imagery strategies (Morris, Nanko and Philips, 1978)	I. Study 1 (all subjects used both imagery)	
	Goal-oriented	1.0×10^{-2}
	Process-oriented	n.s.
	Study 2 (all subjects used both imagery)	
	First session:	n.s.
	Goal-oriented	n.s.
	Process-oriented	
	Second session (subject's imagery choice)	
	Goal-oriented	1.0×10^{-3}
	Process-oriented	n.s.
1979		
The influence of imagery and feedback on PK effects (Levi, 1979)	Goal-oriented/feedback	5.0×10^{-2}
	Goal-oriented/nonfeedback	4.50×10^{-2}
	Process/feedback	n.s.
	Process/nonfeedback	n.s.
	Control/feedback	n.s.
	Control/nonfeedback (Subject or experimenter start in each case above proved insignificant; reported as 12 separate experiments)	n.s.
An investigation into the use of aversion therapy techniques for the operant control of PK production in humans (Broughton, Millar and Johnson, 1979)	I. Subject 1	
	A	n.s.
	B	n.s.
	A	n.s.
	Release of effort	n.s.
	II. Subject 2	
	A	5.0×10^{-2}
	B	n.s.
	A	n.s.

	Release of effort	n.s.
	III. Subject 3	
	A	n.s.
	B	n.s.
	A	n.s.
	Release of effort	n.s.
	IV. Subject 4	
	A	n.s.
	B	n.s.
	A	n.s.
	Release of effort	n.s.

Une Experience avec un Générateur de Nombres Aléatoires : L’origine de la Théorie de la Decision Augmentée

Résumé : En 1979, l’équipe de recherche du SRI International a conduit une experience avec un unique générateur de nombres aléatoires (GNA). Le but était de répliquer et d’étendre les résultats issus de la littérature de plusieurs façons. L’analyse séquentielle était utilisée pour fournir une augmentation en deux temps de la sensibilité statistique ; deux formes d’aléatoire de sources physiques fondamentalement différentes étaient utilisées : la désintégration β de ^{147}Pm et le bruit électronique d’une diode en silicone bien comprise. Des efforts d’ingénierie substantiels ont permis d’isoler ces sources de leurs effets environnementaux, et un modèle de mécanique quantique décrivait adéquatement les propriétés connues du bruit électronique de la diode. Une définition a priori d’un résultat positif était donnée de façon plus stricte que dans les études habituelles ; deux participants sur sept doivent produire indépendamment des preuves significatives d’un effet. Ont pris part à l’étude sept participants dépistés pour leur capacité de PK parmi une population de 17 candidats. Deux ont produit des résultats indépendamment significatifs ($p \leq .021$ et $p \leq .039$, respectivement). Bien que ces résultats soient consistants avec ceux émanant de la littérature sur la micro-PK, nous ne reportons aucune preuve définitive d’effets PK. Les résultats apparaissent plutôt comme le produit du psi informationnel de la part des participants.

Ein Zufallszahlengenerator-Experiment: Der Ursprung der Theorie der Entscheidungsausweitung

Zusammenfassung: 1979 führte das Forschungsteam von SRI International ein Experiment mit einem Zufallszahlengenerator (RNG) durch. Ziel war es, bisherige Erkenntnisse, über die eine umfangreiche Literatur vorliegt, zu replizieren und zu erweitern. Die sequentielle Analyse wurde verwendet, um die statistische Sensitivität in zweifacher Weise zu erhöhen; zwei grundsätzlich verschiedene physikalische Zufallsquellen wurden verwendet: β-Zerfall von 147Pm und elektronisches Rauschen von einer allgemein bekannten Silizium-Rauschdiode. Durch einen erheblichen technischen Aufwand wurden diese Quellen von Umwelteinflüssen abgeschirmt, und die bekannten Eigenschaften der elektronischen Rauschdiode wurden durch ein quantenmechanisches Modell genau beschrieben. Die a priori-Definition für ein erfolgreiches Ergebnis war strenger als beim üblichen Vorgehen; zwei von sieben Teilnehmern mussten unabhängig voneinander einen signifikanten Nachweis für einen Effekt erbringen. Sieben Teilnehmer, die aus einer Stichprobe von 17 Kandidaten auf ihre PK-Fähigkeit überprüft wurden, nahmen an der formalen Studie teil. Zwei erzielten unabhängig voneinander signifikante Ergebnisse ($p \leq .021$ bzw. $p \leq .039$). Während diese Ergebnisse mit denen in der Literatur über Mikro-PK übereinstimmten, berichten wir über den definitiven Nachweis, dass es sich keinesfalls um PK-Effekte handelt. Vielmehr scheint das Ergebnis mit einer psi-bedingten Information seitens der Teilnehmer zusammenzuhängen.

Un Experimento con Generador de Números Aleatorios: El Orígen de la Teoría de Decisión Aumentada

Resumen: En 1979, el equipo de investigación del Instituto de Investigación de Standford Internacional (*SRI International*, por sus siglas en inglés) llevó a cabo un experimento con un único generador de números aleatorios (GNA). El objetivo era replicar y ampliar los hallazgos de la abundante bibliografía en varias formas. Se utilizó el análisis secuencial para duplicar el aumento en la sensibilidad estadística; se utilizaron dos fuentes físicas aleatorias fundamentalmente diferentes: desintegración β de ^{147}Pm, y ruido electrónico de un reconocido diodo de ruido de silicio. Un esfuerzo significativo de ingeniería logró aislar estas fuentes de los efectos ambientales, y un modelo de mecánica cuántica describió con precisión las propiedades conocidas del diodo de ruido electrónico. La definición *a priori* de un resultado exitoso fue más estricta que en los estudios habituales; al menos dos de siete participantes debían producir evidencias significativas del efecto de forma independiente. Siete participantes que fueron evaluados respecto a sus habilidades psicoquinéticas (PQ), de una población de 17 candidatos, participaron en el estudio. Dos produjeron resultados significativos ($p \leq .021$ y $p \leq .039$, respectivamente) de forma independiente. Si bien dichos resultados fueron consistentes con los de la literatura sobre micro-PQ, reportamos evidencia definitiva de que no hubo efectos PQ en absoluto. Más bien, el resultado parece surgir debido al psi informacional del participante.