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DEVELOPMENT OF TECHNIQUES TO ENHANCE MAN/MACHINE COMMUNICATION

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Prepared for:

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
c/o CALIFORNIA INSTITUTE OF TECHNOLOGY
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FOREWORD

In April of 1973, the Jet Propulsion Laboratory initiated a contract with the Stanford Research Institute to explore the potential enhancement of man/machine activities through ESP communications. The contract was initiated at the request of NASA Headquarters, which assigned to JPL the responsibility to monitor the contract and assure an objective experimental environment.

The experiment proposed by SRI was a scientific investigation of ESP and ESP learning through feedback or reinforcement. It was postulated that feedback would bring the phenemena, if such existed, to a readily measurable level. Reinforcement was provided by ESP teaching machines which continuously keep the subject informed as to his performance. The contract Statement of Work called for a totally automated tabulation of data. SRI was specifically funded to construct the teaching machines and to conduct a statistically significant set of trials with a suitable cross section of subjects. The subjects' tasks was to visualize which of several signals was being generated randomly by the machine.

The SRI investigators conducted initial experiments using observers to record experiment results rather than automated equipments. The SRI investigators in the report that follows (unedited by NASA or JPL) drew positive conclusions regarding ESP communications and learning. Further experiments were conducted strictly in accordance with the Statement of Work, using paper tape punch recording of subject choices. JPL review of the experiment results led to the conclusion that the experiments conducted under the controlled conditions eliminate the possibility of interaction between experimenter and observer and reveal no positive evidence of ESP or ESP learning.

NASA has concluded that there is currently no basis for support of further investigations.

Studies, Analysis and Planning Office
Office of Aeronautics and Space Technology
NASA Headquarters

STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 · U.S.A.

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SRI Project 2613

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ABSTRACT

As the complexity of machines increases, the required speed of human interaction with them also usually increases. In the research described in this report we have investigated several approaches to facilitating interactions between man and his machines. In the first phase of this program we made use of a four-state random stimulus generator, considered to function as an ESP teaching machine. A subject tries to guess in which of four states the machine is. The machine offers the user feedback and reinforcement as to the correctness of his choice. Using this machine, we screened 148 volunteer subjects under various protocols and identified several whose learning slope and or mean score departed significantly from chance expectation.

In the second phase of the research we looked for direct physiological evidence of perception of remote stimuli not presented to any known sense of the percipient using electroencephalographic (EEG) output when a light was flashed in a distant room. This work was terminated at JPL's request to permit concentration of remaining funds on the teaching machine experiments.

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PREFACE

This report is the final technical report summarizing the work performed under NASA Contract NAS7-100 Task RD-154 entitled, "Development of Techniques to Enhance Man/Machine Communication," covering the period 15 April 1973 to 15 May 1974. This report was prepared by the Electronics and Bioengineering Laboratory of SRI, Menlo Park, California. This program was under the administrative supervision of Mr. Earle Jones, and the principal investigator was Mr. Russell Targ. Other significant contributors to the program were Ms. Phyllis Cole, Dr. Harold Puthoff, Dr. Richard Singleton, and Dr. Charles Rebert.

The work in this program was administered by the Jet Propulsion Laboratory at the California Institute of Technology, Pasadena, California, under their Contract No. 953653. Mr. Robert Powell was the principal technical representative of the Jet Propulsion Laboratory, as well as the representative of the National Aeronautics and Space Administration, which sponsored the research.

I INTRODUCTION

This final report describes the results of a one-year research program to determine if man/machine communication and extraordinary human perception can be enhanced with teaching machines, making use of feedback and reinforcement. The contract work statement called for a series of tasks that included the fabrication of six teaching machines and their use with a large number of test subjects.

The results of this part of the investigation suggest the existence of one or more perceptual modalities through which individuals can and do obtain information about their environment, wherein this information is not presented to any known sense. Such perceptual abilities are often considered to be paranormal. The literature in the field,[1-3*] coupled with our own observations, have led us to conclude that such abilities can be studied under laboratory conditions.

The phenomena we have investigated most extensively pertain to the ability of certain individuals to choose correctly the present state of a random four-state automatic stimulus generator.

In addition to the teaching machine tasks, the work statement called for SRI to conduct trials to determine the EEG response of a test subject to remote stimuli. During the course of the performance of the contract, the work on EEG trials was terminated at JPL's request to permit concentration of remaining funds on the teaching machine experiments. However, SRI management decided to continue the EEG data analysis without the financial support of NASA/JPL and provided in-house support for the completion of the EEG work. These results will be submitted for publication

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*References are listed at the end of this report.

in the appropriate professional journal at some time in the future.

In all of our work, we conducted our experiments with sufficient control, using visual, acoustic, and electrical shielding, to ensure that all conventional paths of sensory input were blocked. At all times we were vigilant in the design of our experiments to take measures to prevent sensory leakage and to prevent deception--whether intentional or unintentional--on the part of our subjects.

In Section II, we describe experiments in which 148 volunteer subjects interacted with an ESP teaching machine. In this work we sought to determine if subjects could learn to choose the current state of a four-state random stimulus generator. We were looking either for significant learning or consistent extra-chance high scoring. This investigation identified two individuals--working under different conditions--who produced mean scores at a level of significance, $P \leq 2 \times 10^{-6}$. In addition, six subjects--again, under varying conditions--showed significant learning at $P \leq 0.01$, whereas no subject in this experiment produced a negative slope at this level of significance.

In Section III we summarize tests using electroencephalograms (EEG), in which subjects were asked to perceive whether a remote light was flashing, and to determine whether a subject could perceive the presence of the light even if only at a noncognitive level of awareness. These experiments were terminated at JPL's request as has been mentioned.

II THE ESP TEACHING MACHINE STUDY

A. General Introduction

The main hypothesis to be explored in this part of the study was that with practice many individuals might improve their performance on a suitable ESP task.

The machine designed for use in this experiment was a four-choice random stimulus generator which was a congenial and visually pleasing device for the subjects. It was also easily checked for randomness and capable of providing suitable hard copy for computer analysis. Teletype punch output was used for randomness testing but was not used with subjects in Phase III.

An ESP machine, described in greater detail in the following section, randomly selects one of four target 35-mm slides. The subjects then attempt to guess which slide has been selected. Visual feedback is provided for all subject responses, including the option of "passing" on a trial; i.e., making no selection.

The experiment was carried out in four parts, each of which is discussed separately. Phase 0 was a pilot study involving two adult subjects. Phase I consisted of screening 145 subjects, almost half of them children under 15 years of age. Based on results of the data analysis of Phases 0 and I, 14 adult subjects were invited to take part in Phase II, under somewhat different experimental conditions; 12 accepted the invitation to participate. Phase III participants consisted of an adult who had performed well on other SRI ESP tasks, plus four adults and three children, all subjects whose performances were well above chance during

Phases 0 and I. In Phase III experimental conditions were again varied in an attempt to replicate earlier successful results.

B. <u>The ESP Teaching Machine</u>

1. <u>General Description</u>

The Aquarius Electronics ESP Teaching Machine®, designed for this kind of project, presents four art slides to the subject as shown in Figure 1.* The machine is often used with a printer attached, as Figure 2 illustrates. The machine randomly selects one of the four slides as a target, which the subject then tries to identify by pressing the button associated with the slide of his choice. As soon as the subject indicates his choice, the target slide is illuminated to provide visual feedback as to the correctness or incorrectness of the response. If the choice is correct, the number-of-hits counter displayed on the machine is incremented and a bell sounds. The number-of-trials counter displayed on the machine is incremented whether or not the choice is correct.

An important feature of the machine is that the choice per se of a target is not forced. That is, the subject may press a PASS button on the machine when he wishes not to guess. Thus, with practice, the subject can learn to recognize those states of mind in which he can correctly choose the target. He need not guess at targets when he does not feel that he "knows" which to choose.

When the PASS button is pushed the machine indicates what its choice was, and neither a hit nor a trial is scored by the machine, which

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*This machine was first designed and built by Russell Targ and David B. Hurt in 1971 under a grant from the Parapsychology Foundation, New York City, N.Y. The present machines were manufactured by Aquarius Electronics, Albion, California.

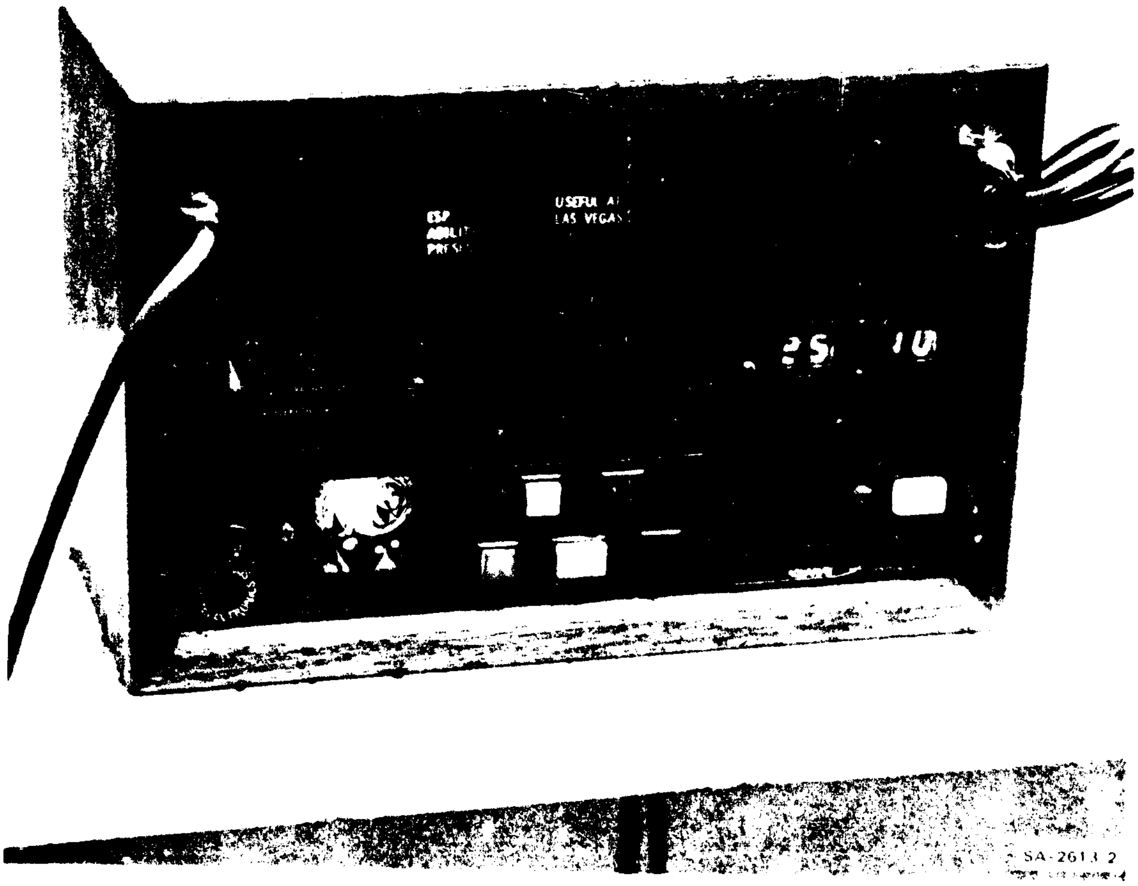


FIGURE 1 ESP TEACHING MACHINE

FIGURE 2 ESP TEACHING MACHINE WITH PRINTER ATTACHED

then goes on to make its next selection. PASSES may be used as often as desired. We consider this elimination of forced choice to be a significant condition for learning ESP.

Because the user obtains immediate information feedback as to the correct answer, he may be able to recognize his mental state at those times when he has made a correct response. If the information feedback to the user were not immediate, we believe as much learning would not take place and less or no enhancement would be achieved.

Five legends at the top of the ESP machine face are illuminated one at a time with increasing correct choices to provide additional reinforcement.

Throughout this experiment, the machines were operated in clairvoyant mode (i.e., the target selection was made by the machine before the subject made his choice). Although the machines are flexible enough to permit several other modes of subject/machine interaction, these have not yet been systematically explored.

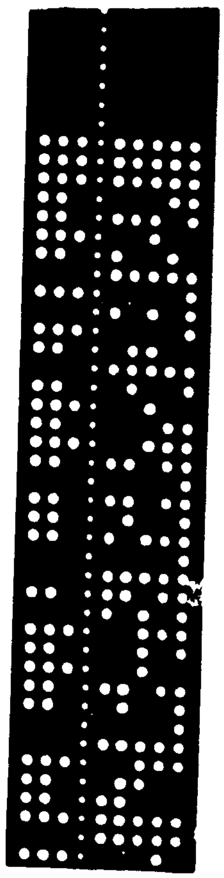
2. Data-Collection Methods

Several data-collection options are available; all were used in different phases of this study. The ESP machine itself displays a counter of the number of trials and hits. When 25 trials are reached, the "reset" button must be pressed before another set of 25 trials can begin. For one Phase 0 subject and for all Phase III subjects, this summary information was recorded on score sheets by an experimenter observing the subject. The other Phase 0 subject recorded his own data.

An Aquarius-produced printer may be plugged into the ESP machine to obtain far more detailed data, which are printed on fan-fold paper. A sample tape is shown in Figure 3(a). Reading from left to right, the information recorded is:

Trial		Score		Machine Choice	Subject Choice	
0	0	0	0	0	4	Reset
2	5	0	7	2	0	
2	4	0	7	1	2	
2	3	0	7	0	3	
2	2	0	7	3	0	
2	1	0	7	0	0	
2	0	0	6	0	3	
1	9	0	6	0	1	
1	8	0	6	1	0	
1	7	0	6	2	2	
1	6	0	5	0	3	
1	5	0	5	2	0	
1	4	0	5	2	0	
1	3	0	5	2	7	Pass
1	3	0	5	2	3	
1	2	0	5	3	3	
1	1	0	4	3	0	
1	0	0	4	2	1	
0	9	0	4	2	2	
0	8	0	3	1	3	
0	7	0	3	0	0	
0	6	0	2	3	7	
0	6	0	2	2	7	
0	6	0	2	0	3	
0	5	0	2	2	2	
0	4	0	1	0	3	
0	3	0	1	2	0	
0	2	0	1	1	1	
0	1	0	0	2	1	

(a) PAPER TAPE GENERATED BY AQUARIUS PRINTER



(b) PUNCHED PAPER TAPE GENERATED BY MODEL-33 TELETYPE

SA-2613-4

FIGURE 3 ALTERNATIVE DATA RECORDING FORMATS

Columns 1 and 2:	number of trials
Columns 3 and 4:	number of hits
Column 5:	target selection, 0-3
Column 6:	subject selection, 0-3 for a slide, 7 for a pass.

Resets are indicated by a "4" in column 6 and zeroes in all other columns. This method of recording data was used for the 145 subjects in Phase I and the 12 subjects in Phase II.

To provide machine-readable data, a Model 33 Teletype can be incorporated into the configuration to produce punched paper tape, as shown in Figure 3(b). A simple coding format enables recording of essentially the same information as that displayed by the Aquarius printer. All of the following items are encoded in one eight-bit column: machine generated target, subject choice, subject pass, correct choice by subject, and finally a parity bit. All eight holes are punched to indicate reset after 25 trials. Tapes generated in this way were run through our central computer to obtain the required checks of machine randomness before subject participation in Phase I.

Punched-paper tapes were also generated for the randomness tests before Phase II and for all subjects during Phase II.

3. Detailed Description of the ESP Teaching Machine

The random target generator consists of a self-starting multivibrator free running continuously at a 1 MHz rate. This is shown in the system block diagram, Figure 4. The clock gate transfers the clock pulse to a scale-of-four counter, or target generator. In this manner a new target is chosen every 1 μs. The function of the synchronous gate is to ensure uniform pulses to the scale of four counter to eliminate any bias in counting pulses.

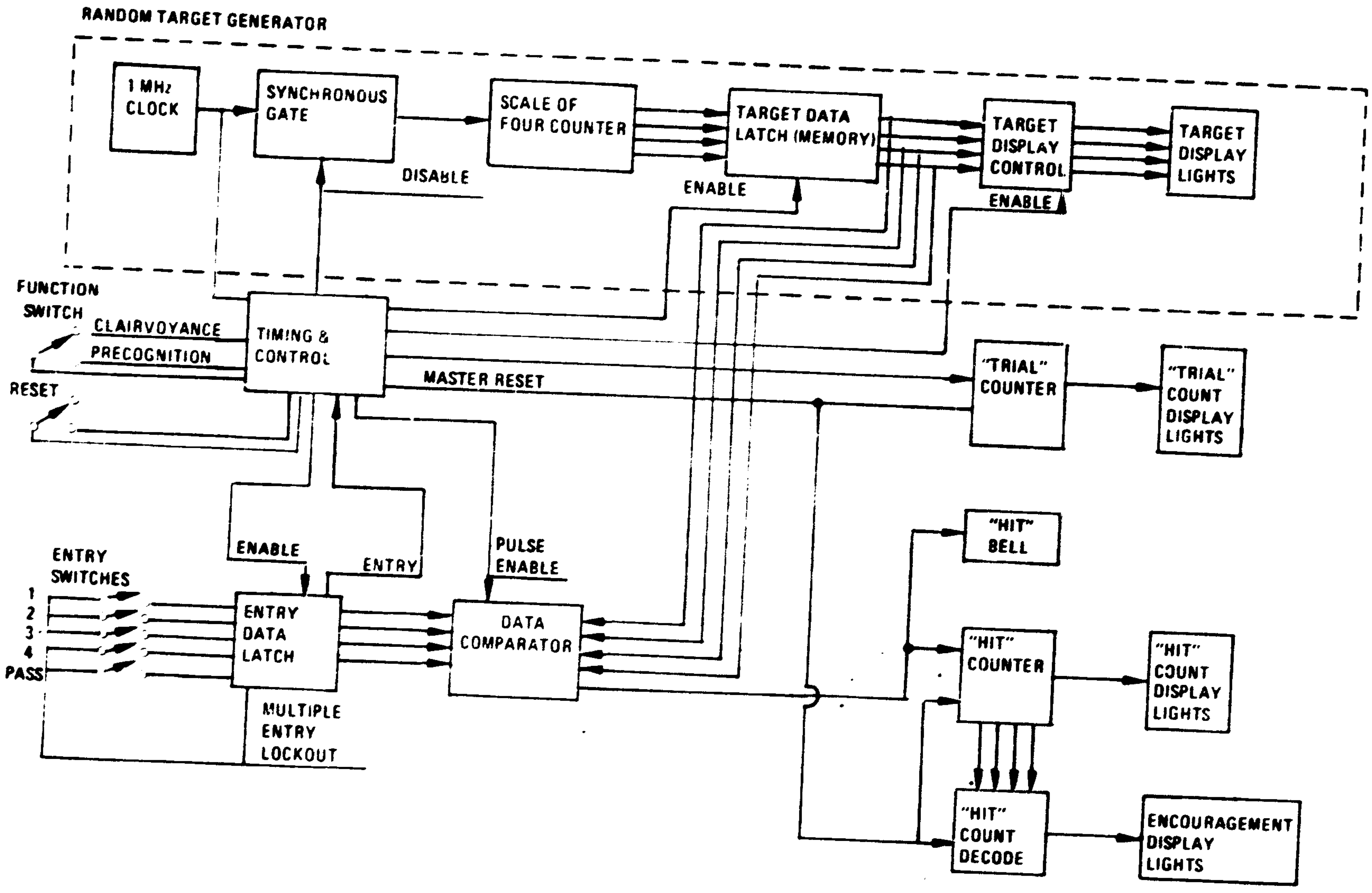


FIGURE 4 BLOCK DIAGRAM OF ESP TEACHING MACHINE

To start a "clairvoyance" trial, the master reset button resets trial and hit counters to zero, disables the clock gate for about 1 ms, and enables the target gate which transfers the last two-bit binary number from the scale-of-four counter to the target latch, or memory. The target gate is then disabled and the clock gate enabled and the scale-of-four counter starts to cycle again. Meanwhile the target binary number remains in the memory. When any of the five entry switches is depressed, its corresponding entry data latch is set and the remaining entry switches are disabled until all switches are released. The target picture is illuminated during the interval that the switch is depressed.

The entry information is decoded and checked against the contents of the memory by the comparator. If the contents of the entry data latch and the target data latch are identical when strobed with an enabling pulse, a pulse is sent to the "hit" counter and the hit bell rings, indicating a correct choice. Also a pulse will be sent to the trial counter. If an incorrect choice is made, only the trial counter is pulsed. If the "pass" switch is depressed, the correct target is displayed, but neither counter is actuated.

After all switches have been released, the synchronous clock gate is disabled and the target data latch is enabled, thereby transferring a new target into memory, ready for the next trial.

When the function switch is in the "precognition" mode, the timing sequence is altered so that there is an initial delay of 200 μs after the entry switch is depressed, after which the new target is selected, the comparator is strobed, and the target display is enabled.

After 25 trials have been made the last target remains on; this indicates that the run is over and the entry switches are disabled until the reset switch is depressed to start a new run.

4. <u>Randomness Tests</u>

The design objective was to build a four-state machine, with each state equally likely to occur on each trial, independent of the past sequence of states. If the machine meets this objective, it should not be possible to devise a rule for future play that significantly differs from chance. A simple example of such a rule would be to select the machine state observed in the preceding trial; if this strategy were to produce scores significantly above chance (25 percent hits), we would reject the hypothesis of randomness of the machine under test.

The preliminary results described in Phase 0 were obtained prior to randomness testing. Before each of the other three Phases in the experiment, the machines were extensively tested for randomness. Data were analyzed on a CDC-6400 computer, and each machine used in the experiment met established criteria for randomness.

a. <u>Phase I Tests</u>

In developing randomness tests, we are guided in part by a knowledge of the machine logic. When one of the four choice keys or the pass key is depressed, the current machine state is displayed; then a brief time after release of the key, a new machine state is established (but not shown to the subject) by sampling the instantaneous state of a high-speed four-state electronic counter. For the machine to be random, the times of dwell of the counter in each of the four states must be precisely equal; otherwise, the distribution of outcomes will be biased. The first randomness test is thus based on tallying the number of occurrences of each of the four states. This test should detect a stable bias, yet may miss a drifting bias. To test for this second possibility we also tally the distribution of outcomes in each group of 100 trials, then compute a likelihood ratio test statistic (see below) for each group. Under the null hypothesis of equal likelihood of the four states, these statistic values are distributed approximately as chi-square with three degrees of freedom and their sum for m groups distributed approximately as chi-square with three m degrees of freedom. This test may also detect stable bias, but is not as powerful for this purpose as the first test. Variable bias of still shorter period, if substantial, can be tested for by tallying the frequency with which the previous machine state is repeated; an overall repeat ratio ("all") significantly above 0.25 is indicative of such bias.

If for any reason the machine were to fail to sample the counter to establish a new state, the previous machine state would be repeated. To test for this possibility, we tally the number of repeats following the depression of each key. A repeat ratio significantly greater than 0.25 should be considered a danger signal.

We also tally the initial machine states following reset and the transitions between states. In each case, the number of occurrences of each of the four possible outcomes should be approximately equal. When repeats are deleted from the sequence of trials ("nondiagonal transitions"), the four states should also be approximately equal in frequency. No tests beyond these one-step transitions were applied.

In testing the null hypothesis of four equally likely outcomes of a trial, a likelihood ratio test[4] is used. The statistic

$$-2 \sum_{i=1}^{4} n_i \, \ell n \left(\frac{n/4}{n_i} \right)$$

under the null hypothesis is distributed approximately as chi-square with three degrees of freedom, with rejection for large values of this statistic. The computer program used in testing randomness includes a subroutine for computing the probability of a chi-square value as large or larger than that observed.

In testing the null hypothesis that the probability of a repeat is 0.25, the binomial probability of obtaining the observed number K or more repeats in N trials is computed. For K greater than 1000, a normal distribution approximation is computed, assuming the statistic

$$\left(\frac{K - 1/2}{N} - 0.25\right)\sqrt{\frac{N}{3/16}}$$

to be approximately normal with mean zero and standard deviation one.

In making the randomness tests before Phase I, the data were recorded directly on punched paper tape. Some initial difficulties were encountered from operating the machine too rapidly--both printer and punching errors occurred. This problem was solved by machine modification to prevent entry of a new choice before completion of the print cycle. The punched paper tapes were then converted to cards on a CDC-6400 computer, using two columns per trial--one for the machine state and the other for the key selected by the subject. The punched cards were used to provide a simple means of combining several sets of trials on a given machine, as input to the analysis program.

The typical test pattern used was six passes followed by twenty-five choices of one color, repeating this for each of the four colors. In this way each of the five keys other than rest were given approximately equal use. Typically, 2,000 to 6,000 trials were made. in each sitting. In the absence of any unusual results in the randomness tests, a minimum of 10,000 trials were made before using a machine with experimental subjects. With 10,000 trials, the expected fraction of repeats is 0.25 with a standard deviation of 3/200 = 0.00866.

A sample computer listing of the results of randomness tests on Machine 4 is included in Table 1. Of the four machines tested, three were found suitable for use in the preliminary screening activity

Table 1

PHASE I RANDOMNESS TESTS--MACHINE 4

	Buttons				Number of Trials	Chi-Sq.	Binom. Prob.
	Yellow	Green	Blue	Red			
Initial states	107	116	113	128	464	1.996	0.57
Transitions	728	764	765	790	3047	2.573	0.46
	777	784	773	863	3197	6.745	0.08
	776	796	810	773	3155	1.158	0.76
	787	852	803	805	3247	2.877	0.41
All states	3175	3312	3264	3359	13110	5.667	0.18
Nondiagonal transitions	2340	2412	2341	2426	9519	2.630	0.45

Diagonal transitions	Key	N-Trials	Repeats	Ratio	Binomial Prob.
	Yellow	2774	705	0.2541	0.313
	Green	2755	674	0.2446	0.748
	Blue	2761	706	0.2557	0.250
	Red	2742	667	0.2433	0.793
	Pass	1614	375	0.2323	0.953
	All	12646	3127	0.2473	0.763

Randomness in groups of 100 trials:

Chi-sq. = 299.6141 D.F. = 345 Prob. = 0.9628 of Phase I. The fourth machine was returned to the manufacturer for adjustment.

b. Phase II Tests

Minor modifications were made to the equipment before Phase II began. After that time, the machines were tested for randomness in combination with different printers. Each machine/printer combination under consideration was tested for 10,000 trials.

The analyses used were the same as those for the randomness tests before Phase I. Two machine/printer pairs were selected for use in Phase II. Five of the twelve subjects used the same single machine/printer combination. The remaining seven subjects used one combination for about one-half of their trials, the second combination the rest of the time.

Data analysis for Phase II subjects was based on trial-by-trial information coded on punched paper tape and included randomness checks on the machines' performances during the experiment sessions. Both pairs of machines performed satisfactorily. There was no indication that any subject had learned--either consciously or unconsciously--to operate the keys in such a way as to defeat the intended sampling of the machine counter to establish a new state.

A sample of the output from this analysis is included in Table 2.

c. Phase III Tests

The procedure for testing the randomness of the machine involved an experimenter making 12,000 trials per machine in a nonrandom fashion while recording the hits per 25 trials. This variation in testing

Table 2

PHASE II ANALYSIS OF RANDOMNESS OF MACHINES' PERFORMANCE DURING SUBJECT A-15's TRIALS

	Yellow	Green	Blue	Red	Number of Trials	Chi-Sq.	Binom. Prob.
Initial states	35	36	31	26	128	1.988	0.5750
Transitions	202	195	183	173	753	2.638	0.4509
	194	190	215	184	783	2.740	0.4335
	197	196	159	186	738	5.242	0.1549
	159	202	180	169	710	5.684	0.1281
All states	787	819	768	738	3112	4.449	0.2169
Nondiagonal transitions	550	593	578	543	2264	2.925	0.4034

	Key	N-Trials	Repeats	Ratio	Binomial Prob.
Diagonal transitions	Yellow	721	166	0.2302	0.898537
	Green	766	180	0.2350	0.841682
	Blue	711	159	0.2236	0.953618
	Red	691	188	0.2721	0.098319
	Pass	95	27	0.2842	0.253749
	All	2984	720	0.2413	0.868193

Randomness in groups of 100 trials:

Chi-sq. = 75.6798 D.F. = 90 Prob. = 0.8598 was necessary to test the device as it would actually be used by the subject, viz. without a printer attached.

Analysis was based on 3,000 trials per target per machine using the data analysis procedures described in the discussion of Phase 1. Data for each target were treated as an individual "subject." Based on the four target results for several machines, one machine was selected for use based on its random appearance using the criteria of mean scores and slope. A single machine was used for all Phase III subjects.

C. Phase 0 Pilot Study

1. Selection of Subjects

Much interest was generated by the arrival of the ESP teaching machine at SRI. Interested friends and employees took time to run 100 trials or so on the device. These informal activities entailed no data collection, and were not considered part of the pilot study. However, two individuals who expressed interest in doing additional work with the machine were asked to become subjects.

2. Data Collection

Subject A1 worked at home, where his (SRI scientist) father recorded his data on prepared score sheets. Subject A2, a scientist not employed at SRI, recorded his own data on the prepared score sheets while working on the machine in an SRI laboratory.

3. Data-Analysis Procedures

A necessary condition for evidence of clairvoyance is a mean score significantly above the 25 out of 100 trials expected by chance. A necessary condition for evidence of clairvoyant learning is a statistically significant positive learning slope. For these reasons, the data analyses focused upon mean scores and positive learning slope. The test scores--the number of correct choices in each group of 25 trials--were punched in time sequence onto cards. The computer program groups these data in sets of 100 trials, then fits a line. Under the null hypothesis of random binomial choices with probability 1/4 and no learning, the probability of observing ≥k successes in n trials is approximated by the probability of a normal distribution value

$$\geq\left(k - \frac{1}{2} - \frac{n}{4}\right)\Big/\sqrt{3n/16} \ .$$

The statistic used to test the slope was

$$\sum_{j=1}^{n} \left(j - \frac{n+1}{2}\right) y_j \ ,$$

which under the null hypothesis is symmetrically distributed about zero with variance

$$n \, \frac{(n^2-1)}{12} \cdot \frac{300}{16} \ .$$

4. Results

Subject A1's mean score of 26.06 per 100 trials over 9600 trials has a binomial probability of 8.4×10^{-3}; his slope of 0.077 has a binomial probability of 1×10^{-6}. Subject A2's mean score of 30.50 over 1400 trials has a binomial probability of 2×10^{-6}; his slope of 0.714 has a binomial probability of 6×10^{-3}.

The data for Subjects A1 and A2 are graphed as hits per 100 trials in Figures 5 and 6, respectively.

5. Discussion

The excellent results of these two subjects led to the decision to modify the machine to permit automatic recording of total scores as well

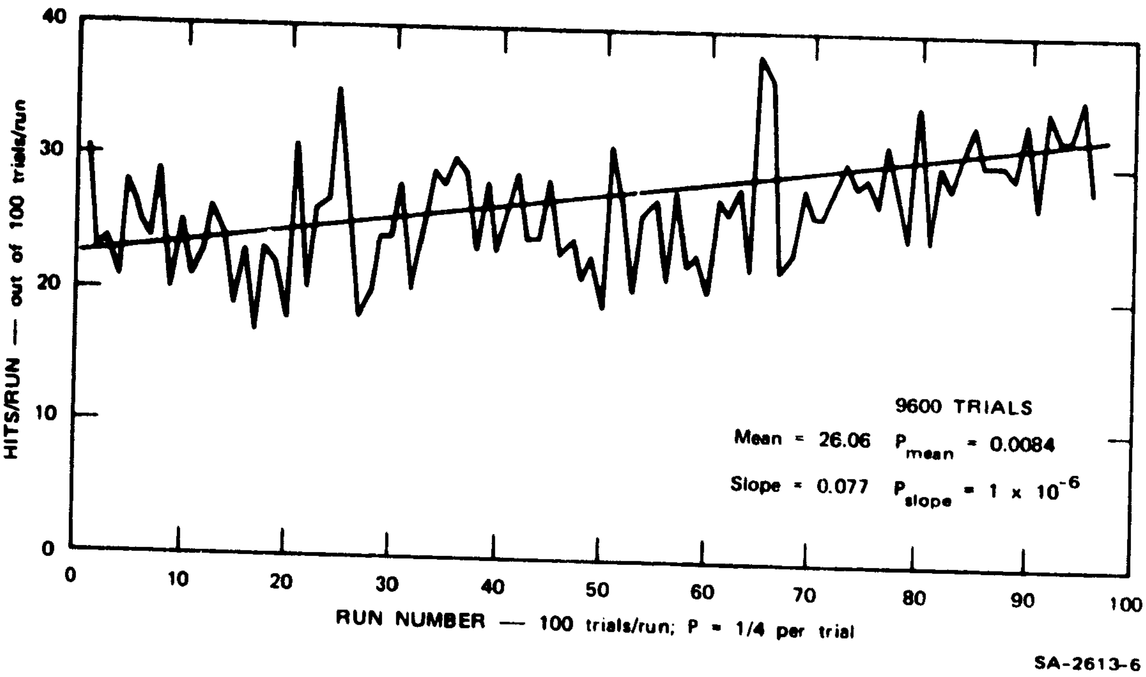


FIGURE 5 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT A1

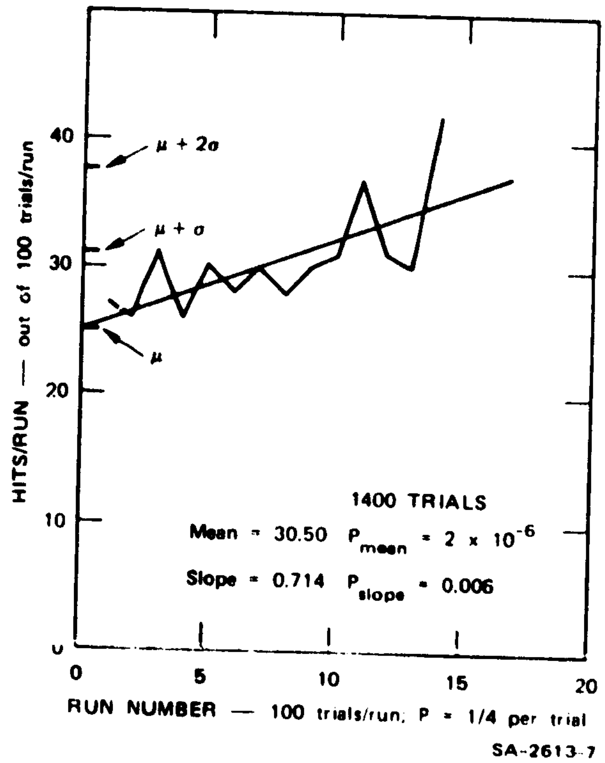


FIGURE 6 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT A2

as more detailed data. After this modification to allow a printer to be connected to the machine, extensive randomness testing was performed. The machine successfully passed these tests. The manufacturers of the equipment assure us that the modification to include the printer should not have changed the randomness of the system. We believe that the performance of these two subjects indicates a man/machine interaction differing significantly from chance expectation.

D. Phase I Experiments

Phase I focused on screening 145 volunteer subjects to ascertain if practice using the ESP teaching machine would improve scoring rates. The screening also was directed toward pinpointing subjects whose mean score was unusually high.

1. Selection of Subjects

Subjects for Phase I came from three main sources:

- SRI: employees, relatives and friends responded to an Institutewide notice requesting volunteers; these volunteers included 79 adults and 21 children under 15.
- A private school; 18 members of a junior high school class participated; 4 somewhat younger students also took part.
- A public school: 23 junior high students were selected by lot from twice that number of volunteers.

Some of these subjects believed that ESP phenomena existed; others did not. Some believed they had had psychic experiences, but the majority did not. The only criterion for participants was the willingness to take part in at least five 15- to 20-minute sessions over a period of one to two weeks.

2. Experimental Conditions

At SRI, each subject worked alone in one of three experimental laboratories. The ESP teaching machine was only one of a number of devices located in any one of these rooms. While the environment was perhaps familiar to participating SRI scientists, it was an unusual setting for most of the SRI staff, nonemployees, and children who participated. Each participant came at the same schedule time for five or more sessions. Each individual worked on two or more machines in different locations over the experimental period.

The private school subjects used the ESP machines in the science laboratory at their school. Each student was assigned a 20-minute time slot for the experiment. Two ESP machines were set up in the laboratory, and at most times during the school day both were in use, while another student or two waited. The experimenter was in attendance for these sessions. The laboratory was kept locked when the experiment was not in progress.

Two ESP machines were set up in the teachers' preparation room at the public school. The equipment was supervised by the teacher or teachers present in the room at any given time. Each student had an assigned 20-minute time each day to work on the machines. This experiment ran over a period of several weeks; while most students worked regularly, many complained of the noise and confusion inherent in the location. Unfortunately, no better site could be located.

While participants at SRI viewed themselves as subjects in an experiments, students at the two schools had a broader view of the situation. The project was treated as a way of introducing these students to some basic elements of the scientific method. Several discussions about the project were held and students were encouraged to ask questions. Data recording was explained, and all students learned to graph their percent of hits.

3. Data Collection and Analysis

A total of 154 subjects had data recorded on the Aquarius printer paper tape. Only 145 persons met the criterion of participating in at least five sessions; the remaining nine persons--six adults and three children--were dropped from the experiment. Of these nine persons, two adults and the three children attended only one session.

4. Results

Table 3 displays data for the 9 of the 145 subjects whose positive learning slopes were statistically significant at the 0.05 level or better. Five of these subjects were adults and four were children under 15 years of age. Data for the 11 of the 145 subjects whose mean scores were significant at the 0.05 level or better are given in Table 4. These 11 subjects include five adults and six children.

Four subjects (two adults and two children) had slopes significant at the 0.01 level or better. Two subjects (one adult and one child) had mean scores significant at the 0.01 level of significance or better. Figures 7 through 12 display a graph of percent of hits per 100 trials for each of the six subjects; the least-squares fit to the data is superimposed.

Table 3

PHASE I ESP TEACHING MACHINE DATA: SLOPE, BINOMIAL PROBABILITY ≤ 0.05

Subject	Number of Trials	Slope	Binomial Probability ≤ 0.05
A9	2300	0.401	0.002
A7	2000	0.409	0.007
A8	3000	0.161	0.039
A5	1900	0.337	0.032
A6	1100	0.718	0.042
C1	2800	0.236	0.010
C2	4500	0.148	0.001
C7	3800	0.110	0.043
C9	8000	0.037	0.038

Note: Subject codes beginning with "C" are children under 15.

Table 4

PHASE I ESP TEACHING MACHINE DATA: MEAN SCORES, BINOMIAL PROBABILITY ≤ 0.05

Subject	Number of Trials	Mean Score	Binomial Probability ≤ 0.05
A3	2800	29.57	$<10^{-6}$
A12	2800	26.71	0.019
A4	7800	25.94	0.029
A10	4700	26.06	0.048
A11	1800	26.72	0.049
C3	3300	26.97	0.005
C6	3000	26.73	0.015
C8	2800	26.61	0.026
C4	2900	26.48	0.034
C5	2400	26.58	0.039
C10	3400	26.62	0.046

Note: Subject codes beginning with "C" are children under 15.

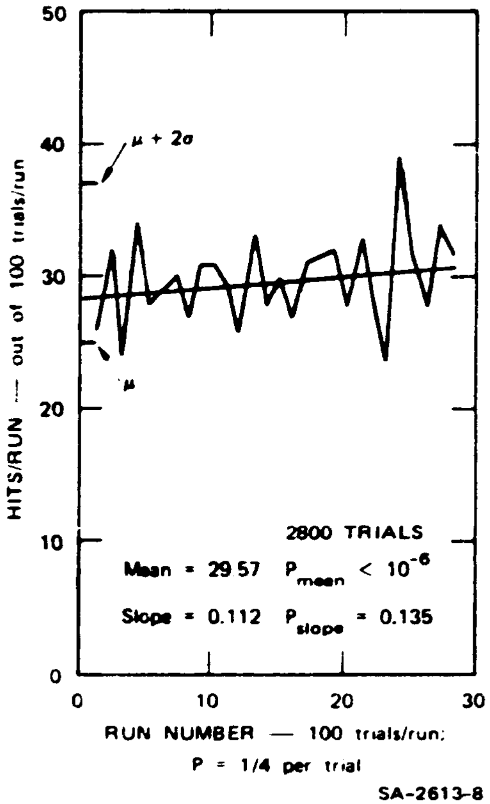


FIGURE 7 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT A3

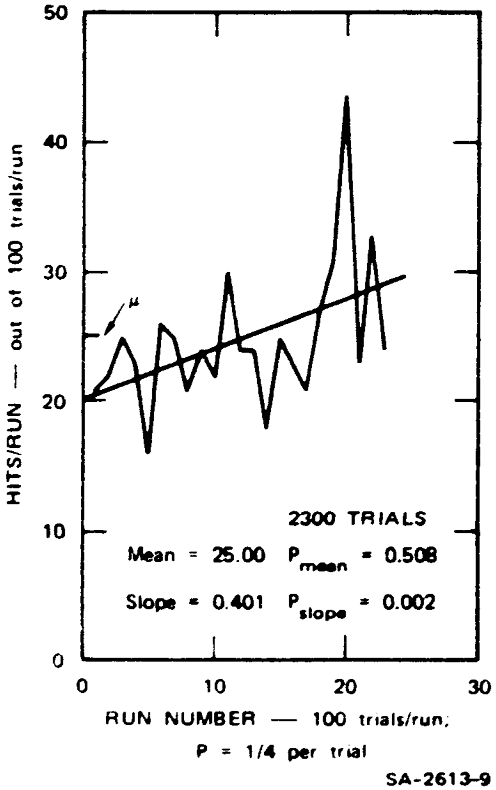


FIGURE 8 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT A9

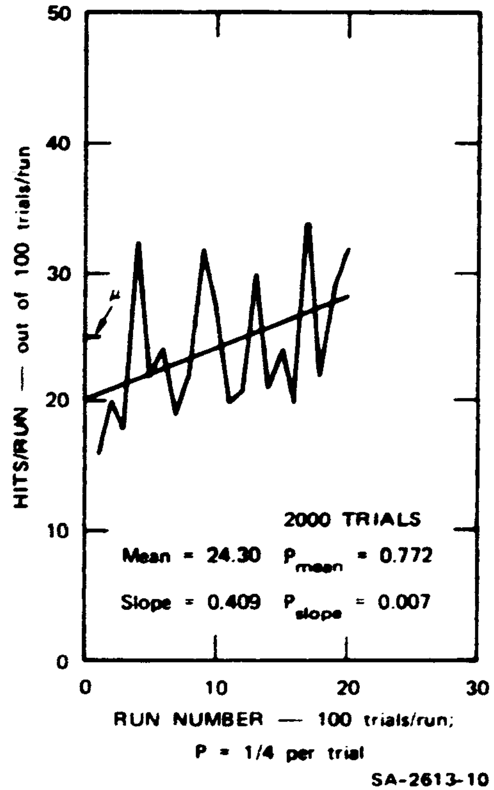


FIGURE 9 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT A7

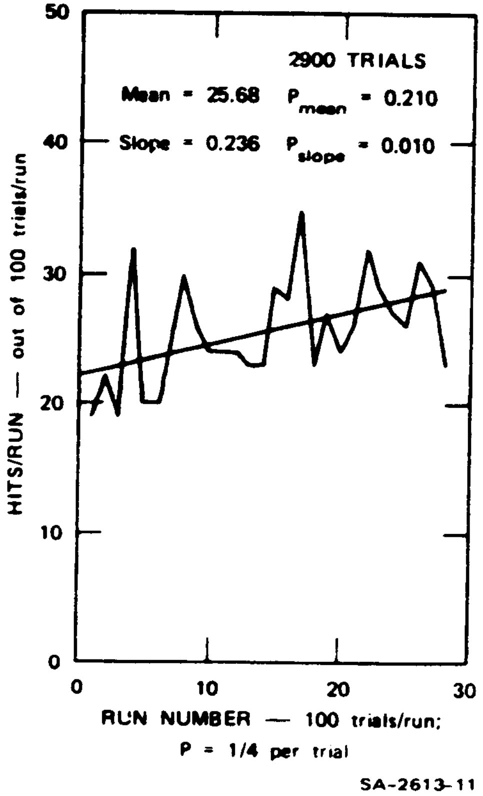


FIGURE 10 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT C1

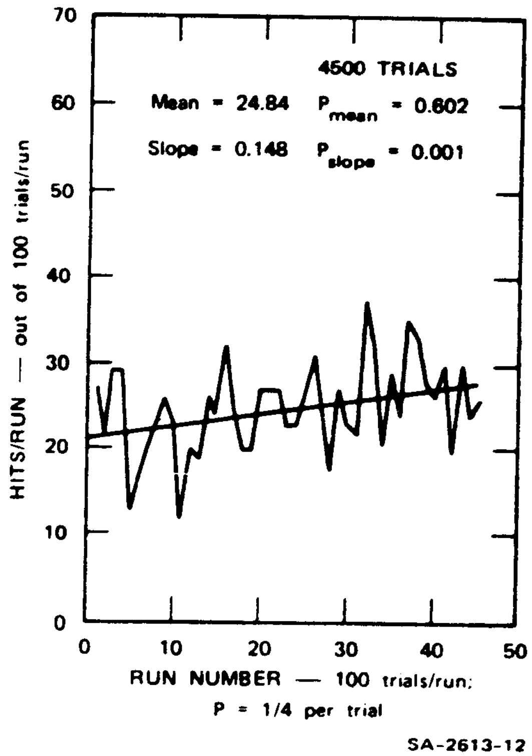


FIGURE 11 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT C2

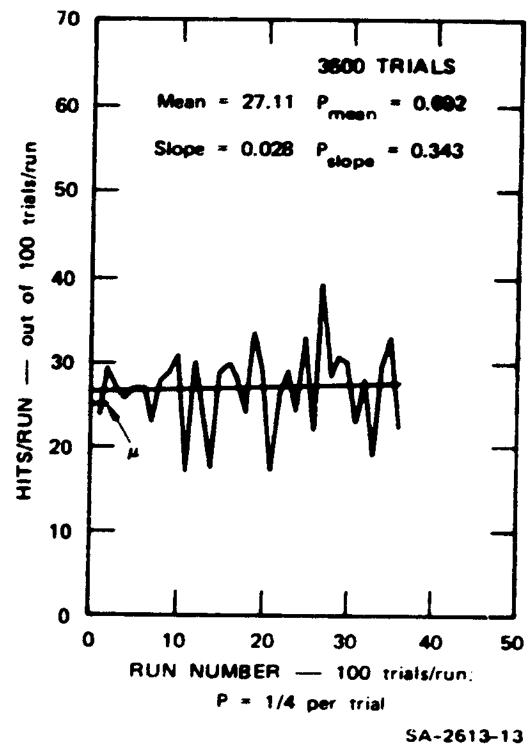


FIGURE 12 SUMMARY OF ESP TEACHING MACHINE DATA FOR PHASE I, SUBJECT C3

5. Discussion

It appears that during the Phase I experiments the population of 145 subjects functions essentially at random: The binomial probability of at least 105,890 hits out of 423,000 trials is 0.310. Even if we include Subjects A1 and A2 (screened in Phase 0), the overall mean score for these 147 subjects remains at chance.

However, four of these subjects (two adults and two children) have a positive learning slope at the 0.01 level of significance or better. The performance of these individuals is far better than that of the rest of the population. Excluding these six subjects, the slopes of the remaining 141 subjects appear to be normally distributed. In fact, no subject had a negative slope at the 0.01 level or less, in contrast to those four who had a positive slope at the 0.01 level.

These results support our conclusion that the ESP machine can serve as a suitable screening device for people, perhaps adults in particular, with certain kinds of ESP ability. While not many people pass this screening test, many of those who do so perform very well indeed. Those so identified were asked to work further with the machines.

An interesting observation derived from a follow-up survey of the adult subjects who participated in either Phase 0 or Phase I is that 37 of the 79 adults contacted practiced some regular form of discipline such as yoga or meditation. However, in our highest scoring adult population (18 at the 0.10 level of significance based on slope or mean scores or both) we find three and one-half times as many meditators/yoga practitioners as nonpractitioners--14 and 4, respectively. This is obviously a small population, but it is nonetheless significant at the 9.1×10^{-3} level.

A variety of information "data," mainly anecdotal, was produced that provided assistance in defining protocols and hypotheses for future experiments. For example, complaints about the noisy printer led to placing the printer in a remote location.

Two main types of strategies were observed: Some subjects worked very slowly, some extremely quickly. About half of the subjects who did very well fell into each category. Both strategies seemed to grow from attempts on the part of the subjects to override their rational urges to try to see patterns in the slides. Although it was carefully explained to all subjects that the machines selected targets randomly, many people still felt there were patterns to be found. This may have in part been because only four targets were used.

Several subjects--including about half of those who scored at the 0.01 level or better--felt that they sometimes seemed to operate in precognitive mode. That is, when attempting to select the correct target for trial N, they were in fact selecting the correct target for trial N+1. No subject was able to successfully sort out the cues that enabled him to determine the state he was in. Examination of Subject A3's data indicates that overall scores for precognition are about at chance level. However, as the subject noted, precognitive "runs" seem to occur. It would be of interest in a future experiment to explore further the precognitive/clairvoyant confusion.

Throughout Phase 1, no observable performance differences were noticed by sex or age; however, no detailed analysis was made.

Subjects uniformly enjoyed participating in this experiment, and many mentioned they would be happy to use the machines again if the chance arose. Several adults specifically mentioned they felt they were learning how to improve their scores; such remarks were often made at a time when merely observing the session's scores provided little support for this notion. Yet many of these same persons--in particular Subjects A6 and A7--did show learning.

The impression that one could learn to outguess a random machine was prevalent, and seemed to become stronger the more attention that was paid to the machine. Numerous subjects bemoaned the fact that when they were "hot" they could perform extremely well, and felt in touch with the machine. The man/machine rapport was mentioned over and over again, but few people were able to verbalize what they meant by this. One of those who was not only verbal but able to replicate his results was Subject A3. His attitudes and interpretations of his methods are discussed more fully under Phase III and in Appendix A.

In an attempt to encourage verbalization, an informal oral survey was given each participant at the private school after his participation in the experiment. The results, tallied in Table 5, parallel comments from adult subjects as well as other children. Questions 3 and 3a are of particular interest: Many students tried to get low scores. This tendency to experiment with different modes of interacting with the machine was not taken into account in recording or analyzing data.

E. Phase II Experiments

The goal of Phase II was to do additional work with subjects who had performed well during the earlier phases of the experiment. The inquiry was directed toward several areas:

- Replication of earlier results.
- Improved performance by creating a more congenial experimental environment.
- Collection of data in a directly machine readable format to allow more detailed analysis of subject responses and machine performance.

Table 5

RESULTS OF ESP EXPERIMENT QUESTIONNAIRE

Ss = 22 boys and girls ages 10-14
Given Oct. 1 and 2, after 7 experimental sessions of 20 minutes each

1. Do you think you learned anything?

Yes: 11 No: 7 Don't know: 4

1a. What?

Answers vary.

2. What sort of things did you do to get high scores?

Not thinking: 6
Fast pressing: 6
Found patterns: 5
Just pushed: 3
Followed feelings: 2
Other: 5

2a. How did you feel?

Varies: 8
Feeling good helps: 6
Other: 6

3. What sorts of things did you do to get really low scores?

Avoid right answers: 8
Find patterns: 3
Other: 9

3a. Did you try on purpose to get low scores?

Yes: 15 No: 7

3b. How did you feel?

Varies: 6
Maybe not so good: 4
Usual: 5
Don't know: 3
Other or no response: 5

4. What did you think you were doing?

Mostly guessing: 8
Some ESP, some guessing: 6
Mostly ESP: 2
Guessing at first, then more ESP: 2
Don't know: 2
Sometimes light/action around correct button: 1
When really fast, more ESP: 1

5. Did you like the experiment?

Yes: 22 No: 0

5a. Would you like to be in a similar experiment some other time?

Yes: 21 Maybe: 1 No: 0

6. Other comments:

Nice time during experiment: 3
Don't like printer: 3
Trying hard to get high scores led to low scores: 4
Low scores often occurred after high scores: 2
Other remarks: 9

1. Selection of Subjects

Criteria for selecting subjects for this part of the experiment included statistically significant slopes or mean scores during Phase 0 or Phase I. Adult Subjects A3 through A8, whose records are shown in Table 3, participated in this portion of the experiment, as did Subject A2, a Phase 0 participant. Subject A9 declined to take part because she believed she had learned to achieve high scores on the machine and had no further interest in it.

Five additional adult subjects took part. Subject A13 has demonstrated some paranormal ability in other tests conducted at SRI. Subjects A14-A16 are individuals whose slope was between the 0.05 and 0.06 levels of significance. Subject A17 showed significant promise of improvement, based on comparisons on number of hits in the second half of the data as compared to the first half. Three of these five individuals believe that they have had personal ESP-related experiences.

2. Experimental Conditions

Several protocol changes were made to enhance the experimental conditions. The most dramatic change was reconfiguring the equipment so that the fairly noisy printer was remote from the subjects. Several dozen Phase I participants had complained that the clatter of the printer was a distraction.

A second change was to provide a single experimental setting in a living-room like environment. The overhead fluorescent lights were replaced by table lamps. Equipment not pertinent to the experiment was removed from the room.

Finally, subjects were asked to work on the ESP Teaching Machine only when they wished to do so. Such flexible schedules were an attempt to promote positive attitudes toward each session with the machine.

3. Data Collection and Analysis

The printed paper tape and punched paper tape described in Section II were used as data-collection devices in Phase II. Both the printer and the Model 33 Teletype that generated the punched paper tape were located in an experimenter's office approximately 40 ft from the subjects' experimental room.

The statistics calculated for this portion of the experiment were essentially the same as those described for Phase I data, namely, the mean and the learning slope, and the binomial probability for each of these. However, rather than analyze the trials in blocks of 100, as was done in earlier analyses, the punch paper tape input of detailed data allowed trial-by-trial calculations to be performed.

As previously mentioned, this form of input also permitted randomness tests to be performed on data during experimental trials. Results indicated the machines were performing suitably throughout Phase II. A sample output from these tests for Subject A6 is included as Table 2.

4. Results

No subjects performed significantly better than chance throughout Phase II. The slope, mean, and the binomial probability of each are given in Table 6. Under these conditions, then, no ESP learning occurred.

An additional experiment was performed with Subject A13: We attempted to establish whether money would serve as a motivator to achieve high scores for this individual. Of the more than 20,000 trials performed by A13 during Phase II, about 13,500 were under the following payment schedule for scores greater than or equal to 10 per set of 25 trials:

Table 6

PHASE II ESP TEACHING MACHINE DATA

Subject	Number of Trials	Slope (binom. prob.)	Mean (binom. prob.)
A2	4824	4.1×10^{-7} (0.464)	25.24 (0.351)
A3	1698	1.3×10^{-5} (0.271)	25.32 (0.388)
A4	4529	-4×10^{-4} (0.767)	25.63 (0.180)
A5	2424	3.6×10^{-6} (0.386)	24.92 (0.545)
A6	3017	6×10^{-6} (0.238)	25.42 (0.302)
A7	2274	1.7×10^{-5} (0.114)	24.71 (0.631)
A8	4650	6.1×10^{-6} (0.096)	25.57 (0.188)
A13	21,488	4.3×10^{-7} (0.182)	24.98 (0.528)
A14	5820	-9.9×10^{-7} (0.616)	24.93 (0.554)
A15	4824	-1.3×10^{-5} (0.975)	23.21 (0.994)
A16	8459	-2.9×10^{-6} (0.933)	24.04 (0.979)
A17	1325	-1×10^{-5} (0.632)	24.38 (0.709)

$1 for a 10

$2 for an 11

$5 for a 12

$10 for a 13

$20 for a 14

While the subject was highly motivated to generate many trials, the number of scores greater than or equal to 10 generated during these money-motivated sessions did not differ significantly from the number of scores greater than or equal to 10 generated when money was not a motivator, or from chance expectation.

5. Discussion

The data analysis of the 12 Phase II subjects reveals no significant departure from chance expectation. Two factors may partially be responsible.

First, the subjects were definitely aware that they were in a test situation, despite attempts to provide a quiet, pleasant, nonthreatening atmosphere. All knew they were selected to participate because they performed well during the screening process, and this knowledge created varying degrees of tension associated with these performance expectations, according to interviewed subjects.

The subjects in this experiment have uniformly complained about the new experimental conditions in that "It all feels different, being connected to a computer" despite the fact that the new working conditions were much quieter and more congenial than those in the pilot studies. We have spent considerable time interviewing the more articulate of our previous high-scoring subjects. From these conversations we have determined that they have lower levels of confidence when working with the printer connected to the teaching machine than they do when working with an experimenter watching them. And they have the least comfort when working with the teletypewriter punch operating. We have not done blind studies to confirm these perceptions, but they are certainly supported by the decline in scoring rate observed as we have progressed through the three recording techniques used in the program.

We therefore propose the following hypothesis: The subject in these experiments interacts with the experiments in a holistic fashion. That is, the experimental variables that should be considered include the observation techniques as well as the overt experimental conditions. When dealing with sensitive or low level systems (such as a photon-limited communication channel), the quantum effects introduced by the observer must be taken into account. Based on arguments by E. P. Wigner in his book Symmetries and Reflections,[5] we may hypothesize that increasing the complexity of the observation system for an event makes the event increasingly sensitive to "observer" effects. Therefore, we may have a situation wherein the more complex configuration for observing a subject's performance causes greater perturbation of his perceptual channel.

F. Phase III Experiments

Given the results of Phase II experiments, we wished to examine the hypothesis that the more complex the observation system of a subject's performance, the more gross is the perturbance of his perceptual channel. Based on results from Phase 0 through II, we tentatively hypothesized that the observer effect is least when a familiar experimenter records the data. The effect is more noticeable when the printer is used, and most noticeable when both a printer and teletype are used to record the data.

In phase III we attempted to rehabilitate selected subjects' high scores by returning to the experimental conditions of Subject A1 in Phase

0, when an observer seated with the subjects recorded the score at the end of each set of 25 trials.

1. Selection of Subjects

Subjects were selected for phase III experiments on the basis of results of the Phase 0 pilot study and the Phase I screening process. Selected subjects had a statistically significant scoring rate or a learning curve with a positive slope deviating by a significant amount from the null condition. Eight of the original 147 subjects fell into one or both of these categories at the 0.01 level of significance or better. Of the eight subjects, six (four adults and two children) had slopes significant to this degree and four (three adults and one child) had significantly high mean scores beyond the 0.01 level. The probabilities of the slopes were 0.010, 0.001, 0.002, 0.006, 0.007, and 1×10^{-6}. The binomial probabilities of the mean scores were 0.002, 0.008, 2×10^{-6}, and $< 10^{-6}$. Seven of these eight subjects participated in Phase III; the eighth subject declined to participate. Subject A13, who had performed well on other SRI ESP tests, also took part in Phase III.

2. Experimental Conditions

Adult subjects in Phase III usually worked in the familiar living-room-like laboratory at SRI that most of them used during Phase II. The same experimenter was in the room with each participant during each session. For each subject, at least one session took place at his home.

All sessions with the three junior high school subjects were in their homes. The same experimenter worked with these subjects.

3. Data Collection and Analysis

Phase III data consisted of the number of hits per 25 trials scored by each subject. The scores were recorded by the experimenter observing subject performance. A single ESP machine was used by all subjects in all sessions.

The data were analyzed using the procedures described for Phase I.

4. Results

Table 7 gives the slope, mean, and binomial probability of both for all subjects except A3. The protocols used with Subject A3 were somewhat different than those used with the other subjects.

Table 7

PHASE III EPS TEACHING MACHINE DATA

Subject	Number of Trials	Slope (Binom. Prob.)		Mean (Binom. Prob.)	
A1	11,000	0.0042	(0.373)	25.27	(0.258)
A2	2,500	0.0038	(0.489)	25.36	(0.347)
A7	2,700	-0.0501	(0.681)	25.22	(0.403)
A13	4,800	0.0289	(0.261)	26.02	(0.053)
C1	4,400	-0.0621	(0.887)	25.48	(0.238)
C2	5,600	0.0270	(0.225)	25.696	(0.117)
C3	2,800	-0.1762	(0.959)	23.93	(0.908)

Subject A3 was the only Phase I participant whose scores were recorded on the printer but whose results were highly significant nonetheless. His mean of 29.57 over 2,800 trials was significant at a level less than 10^{-6}. His consistently high scores produced a slope of only 0.135, which has a binomial probability of 0.112.

During Phase II, Subject A3's results were at the level of chance, as were those of the other eleven subjects.

Throughout Phases I and II, Subject A3 proved extremely articulate in describing his subjective impressions of what took place both when he performed well and also when he performed poorly on the ESP machine. His comments on his perceptions are included as Appendix A.

During the Phase III trials, Subject A3's subjective impressions of learning the clairvoyant task were clarified and verbalized, as Appendix A indicates. Early in the experiment he expressed a desire for practice sessions at various points during the experiment. Such sessions were instituted at the subject's request throughout the remainder of the experiment for this subject only. These practice sessions were observed by the experimenter to serve one or more of the following functions. Each session:

- Permitted man machine rapport to be established before "real" testing on the machine, or
- Created a low-pressure environment in which the subject could experiment with different modes of interpreting intuitive data, or,
- Allowed the subject an opportunity to regain a lost feeling of rapport with the system without penalizing his performance (previously the subject would terminate a session as soon as he felt rapport was lost).

Subject A3 specified prior to any set of trials whether he wished to practice. Table 8 shows the results of this experiment. The total data list was constructed by chronologically interweaving practice and real sessions before performing the analysis.

Table 8

PHASE III ESP TEACHING MACHINE DATA FOR SUBJECT A3

Session	Number of Presentations	Slope (Binom. Prob.)	Mean (Binom. Prob.)
Trials	2,500	0.0338 (0.390)	27.88 (4.79×10^{-4})
Practice	4,500	-0.1179 (0.991)	25.40 (0.273)
Total	7,000	-0.0571 (0.987)	26.29 (6.75×10^{-3})

5. Discussion

Subject A3 was able to successfully replicate a high mean scoring rate during Phase III. Of particular interest is the difference between results on "real" trials, whose mean score of 27.88 over 2,500 trials has a probability of 4.19×10^{-4}, and the results of the practice sessions, whose mean score of 25.40 over 4,500 trials has a probability of 0.273. This dramatic difference supports the subject's use of practice sessions as a tool to explore man/machine interaction and to develop skills for "real" trials.

None of the remaining seven subjects had a significantly high positive learning or mean score. Subject A13, who has performed well on a variety of other ESP tasks, had a mean score of 26.02 over 4,800 trials which approaches significance at a level of 0.053.

These results suggest that the practice sessions may be a key to creating the appropriate learning environment for what is apparently a very difficult task.

G. Conclusion

During the Phase 0 pilot study and the Phase I screening of 147 subjects, eight subjects had results well beyond chance expectations. Six subjects showed learning with the machine at a level of significance with $P \leq 0.01$. In fact, no subject in the study had a negative slope at the 0.01 level or less. The probability of obtaining this number of subjects at this level by chance is $P = 3.8 \times 10^{-3}$. This leads us to conclude that the ESP machine can help screen certain individuals who are able to establish an unusual degree of man/machine rapport.

In the Phase III study one individual was able to significantly replicate his Phase I results and six others were unable to do so. Many subjects have suggested changes in the experimental environment. Three main aspects were considered:

- The Phase II results suggest that the more equipment used to observe a subject's performance, the more perturbed the subject's perceptual channel becomes, since paranormal phenomena were not apparent here.

- The test-taking pressure generated by the subject's awareness of being chosen because of superior performance must be minimized.

- The chance for a subject to "practice" rather than be tested should be available at the subject's request.

All three modifications of protocol need to be explored in depth under controlled conditions to help identify crucial parameters in successful man/machine interaction.

III EEG EXPERIMENTS

This section briefly summarizes experiments undertaken to determine whether a physiological measure such as EEG activity could be used as an indicator of information transmission between an isolated subject and a remote stimulus. We hypotnesized that perception could be indicated by such a measure, even in the absence of verbal or other overt indicators. In other words, this experiment examines the hypothesis that perception may take place at noncognitive levels of awareness and be measurable, even though not expressed verbally.

It was assumed that the application of remote stimuli would result in responses similar to those obtained under conditions of direct stimulation. For example, when normal subjects are stimulated with a flashing light, their EEG typically shows a decrease in the amplitude of the resting rhythm and a driving of the brain waves at the frequency of the flashes. We hypothesized that if we stimulated one subject (a sender), in this manner the EEG of another subject (a receiver), in a remote room with no flash present, might show changes in alpha (9-11 Hz) activity, or possibly EEG driving similar to that of the sender.

Applying this concept, we informed our subject that at certain times a light was to be flashed in a sender's eyes in a distant room, and if the subject perceived that event--consciously or unconsciously--it might be evident from changes in his EEG output. The receiver was seated in the visually opaque, acoustically and electrically shielded double-walled steel room shown in Figure 13. The sender was seated in a room across the hall from the EEG chamber at a distance of about 7 meters from the receiver.

In order to find subjects who were responsive to such a remote stimulus, we initially worked with four female and two male volunteer subjects, all of whom believed that success in the experimental situation might be possible. These were designated "receivers." The senders were either other subjects or the experimenters. We decided beforehand to run one or two sessions of 36 trials each with each subject in this selection procedure, and to do a more extensive study with any subject whose results were positive.

A Grass PS-2 photostimulator placed about 1 meter in front of the sender was used to present flash trains of 10 s duration. The receiver's EEG activity from the occipital region (O_Z), referenced to linked mastoids, was amplified with a Grass 5P-1 preamplifier and associated driver amplifier with a bandpass of 1 to 60 Hz. The EEG data were recorded on magnetic tape with an Ampex SP 300 recorder.

On each trial, a tone burst of fixed frequency was presented to both sender and receiver, and was followed in one second by either a ten-second train of flashes or a null flash interval presented to the sender. Thirty-six such trials were given in an experimental session, consisting of 12 11 trials--i.e., no flashes following the tone--12 trials of flashes at 6 flashes per second (fps), and 12 trials of flashes at 16 fps, all randomly intermixed. Each of the trials generated an 11-second EEG epoch. The last 4 seconds of the epoch was selected for analysis to minimize the EEG desynchronizing action of the warning cue. This 4-second segment was subjected to Fourier analysis on a LINC 8 computer. This work was terminated by JPL to permit concentration of remaining funds on the teaching machine experiments.

IV CONCLUSIONS AND RECOMMENDATIONS

The goal of this program was to develop techniques to enhance man/machine communication. The primary means we chose to accomplish this goal was through use of the four-state random stimulus generator described in this report.

In the course of our work with this machine, we were able to identify at least two subjects who obtained highly significant positive learning slopes of the order of one in a million. In addition, we found significantly more subjects showing high learning than would be expected from the binomial distribution for the 148 subjects in the study. However, no evidence was found for ESP learning when automatic data logging and teletype printout were used.

From our research on this program we have concluded that there is evidence for paranormal functioning resulting from our work with the ESP teaching machines.

Based on our overall experience in this area, it appears that forced-choice perception tasks are more difficult--and therefore less satisfactory than one would like for the engendering of paranormal perception--as compared with other possible approaches offering more of an opportunity for free response. Subjects indicate that when faced with a very limited choice in a perception task of this type, they tend to generate internal stimuli from their memory of previous targets and then guess based on these internally generated impressions. In our experience with free-response situations, on the other hand (e.g., the remote viewing experiments where a subject has no preconception as to the nature of the target) the subject finds himself in a more open and unbiased state than in the limited choice situation.

From the experiments described in this report we believe that we have learned certain things about paranormal perception. It seems clear that it is necessary for the percipient to be in a state of consciousness which is altered to some extent from his usual state in the sense described by Tart.[6] It appears that the repetitive nature of the teaching machine is one reason that it is a less than optimum tool for studying the phenomenon, because it tends to keep the subject in an analytical state of awareness.

Given the lack of significant learning in the machine experiments, there is the possibility that it is more appropriate to consider the problem from the standpoint of screening or granting permission for subjects to demonstrate paranormal ability, rather than from the standpoint of teaching. Since at the present time society reinforces negatively the demonstration of paranormal ability, it may be assumed that such abilities are repressed, denied, and extinguished to a significant degree. Our work does suggest that it is feasible to train or encourage subjects to develop their latent ability for making use of imaginative and non-repetitive stimuli in a supportive and enabling atmosphere.

In conclusion, we have found that it is possible to conduct meaningful and well-controlled laboratory experiments in this area, while maintaining a supportive setting for the subjects so they will have the will to develop their paranormal skills, and we recommend that work continue to accomplish these objectives.

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Appendix

PERSONAL OBSERVATIONS ON THE USE OF SRI'S ESP TEACHING MACHINE

Appendix

PERSONAL OBSERVATIONS ON THE USE OF SRI'S ESP TEACHING MACHINE*

The following notes are based solely upon my experience and I therefore make no claim that they are generalizable to other persons. Since I am still learning about ESP phenomena, I am confident that additional work in this area will expand, modify, and refine the perceptual processes discussed below. While I have tried to describe these experiential processes with as much precision as possible, the use of seemingly precise language should not leave the impression that the perceptions themselves were equally precise. To the contrary, I found these perceptions to be delicate, transient and ephemeral--and yet, at the same time--and somewhat surprisingly--unmistakably real.

1. Perceptual Processes

Working with the ESP machine proved to be a venture into unfamiliar perceptual territory which functioned according to new and different rules. It took some time (five hours or so with the ESP machine) to begin to learn not only which perceptual processes would work but, equally important which would not work. There was clearly a learning process in finding those delicate and subtle internal cues that would allow me to make perceptually based choices. After approximately 1000 trials with the ESP machine, five dominant perceptual modes emerged. Subsequent

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work with the machine seemed to essentially expand and refine these perceptual processes that emerged initially.

Direct Knowing (Used approximately 5 to 15 percent of the time)--This perceptual cue came as a "gift" that I did not have to work for. This is not to say that this "cue" was always right, but when there was a direct perception of the appropriate response unmediated by any of the other cues described below, my chances of being right seemed quite high (say 75 percent of the time). Internally, this was simply the feeling that I should push one specific button and the knowing was almost immediate. If it were not immediate then, typically, one of the other cues would be used.

"Closure Cues" (Used perhaps 75 percent of the time)--This cue manifested itself in a variety of ways; a sense of "fullness" with respect to a particular button, an internal anticipation of the bell ringing, a sense of "hardness" or "firmness" and a sense of being "locked into" the correct response. The validity of this cue could be tested by acting and thinking as if I were going to push a particular button and then noting the extent to which these "closure cues" became present. This sense of active intentionality--both physically and psychologically--seems important in that it allowed me to sort out many real from imagined perceptions. Also, this cue often gave a kind of veto power; i.e., it did not necessarily assure me as to the right answer but it would tend to tell me if I had picked the wrong one, i.e., I would not experience the aforementioned cues.

Pattern Recognition (Negligible use initially, but then used approximately 75 percent of the time during Phase IV)--Although I used this perceptual mode very infrequently during the initial stages of the experiment, it emerged rather naturally toward the end. This was similar to the "direct knowing" but not isolated to a single button; rather, there was a sense of the next two to three buttons that would be the correct responses. These perceptual cues were obtained in a less objective/rational way and in more of a meditative state, highly concentrated but without specific focus on a particular button. Interestingly, in using this perceptual process, I was able to go somewhat faster and have greater access to all of the buttons in an equivalent way (see the second point under Section 2 next page). Thus, this mode had the advantage of loosening habituated perceptual patterns but it also made selections less amenable to conscious control and testing. This process proved to be either highly accurate or highly inaccurate. Accuracy seemed to be a function of the degree to which I could become synchronized with the evolving pattern of machine selected choices--and it was easy to get out of phase/sequence with this pattern.

Rational Guessing (Used approximately 5 percent of the time)--Although I virtually never did try to superimpose some rationally predicted pattern upon the random, machine selection of buttons, I would sometimes temper my selections (very seldom for the better) by noting that one button had come up too often for it to be likely on the next trial or, conversely, it had come up so seldom that it should be given special consideration as a likely possibility on the next trial. Again, although this was a tempting strategy, I found that random processes were not amenable to rational anticipations and my rational guesses seemed often to be wrong.

Tension Vector Analysis (Used approximately 75 percent of the time)--Here the cue was manifested as a sense of tension(s) pulling in one direction or another with the selection buttons as the locus for that tension. The cue was also manifested as a feeling of "emptiness" and conversely as a sense of "fullness." To describe this process further, it felt analogous to vector analysis in physics where, in sorting out competing tugs and pulls, one finds the "dominant" vector; i.e., the one with the strongest "pull" or the one that best "balances" the other vector tensions. Figure A-1 illustrates this phenomenon.

Although the tension/vector cues were very useful and among the most reliable of all the cues, I found them to be at times quite misleading. The source of confusion stemmed from the role of time as a variable rather than a constant in extrasensory reality (discussed in more detail under section "Comments on Perceptual Processes"). If my assumptions as to the temporal nature of my perceptions did not fit with the actual nature of those perceptions, then the perceptions were quite misleading. (Recall that clairvoyance refers here to a button that will be selected in the future--typically the next trial). The nine-cell matrix shown in Figure A-2 may clarify the complexity of the perceptual process, the need for discriminating awareness and the possibility for error. Out of nine possible combinations of the assumed/actual nature of perceptions, only three are matched or congruent and yield accurate understandings. Each of these primary cases is discussed below:

- Clairvoyant--Here the feeling which allows sorting and selection is like that described in Figure A-1.
- Precognitive--The feeling, sorting, and selection is like that described in Figure A-1 with clairvoyance; the primary difference being a shift in the time dimension to refer, not to the present target of the machine, but to the one to be selected next. To act on this perception I would press the pass button to bring the future into the present and then press the button that corresponded to my precognitive perceptions.
- Clairvoyant and Precognitive--The perception is of a pattern of buttons, distributed through time, that are and will be selected by the machine--the "pattern" usually consisted of two to three buttons. Again, the time variable was most

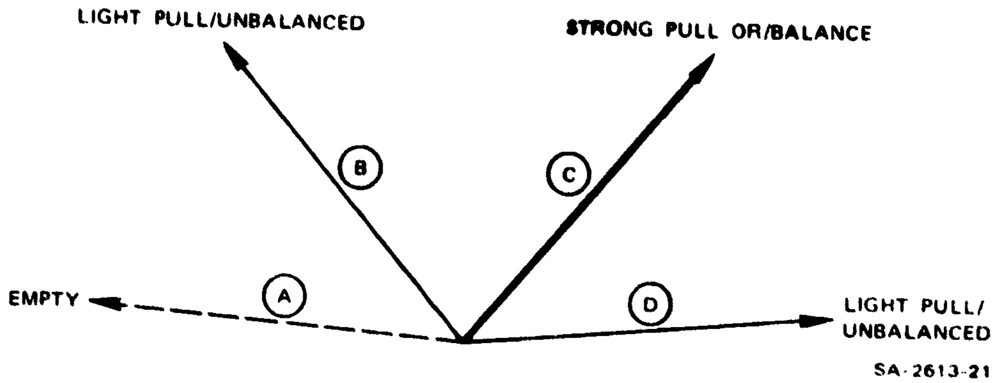

FIGURE A-1 ILLUSTRATION OF TENSION/VECTOR ANALYSIS IN OPERATION
With Button C being the one selected using these cues.

ACTUAL NATURE OF PERCEPTIONS

ASSUMED NATURE OF PERCEPTIONS		Clairvoyant	Precognitive	Clairvoyant and Precognitive
	Clairvoyant	Correct Perception	Misperception	Misperception
	Precognitive	Misperception	Correct Perception	Misperception
	Clairvoyant and Precognitive	Misperception	Misperception	Correct Perception

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FIGURE A-2 MATRIX SHOWING CORRECT PERCEPTION AND MISPERCEPTION IN THE USE OF TENSION/VECTOR CUES VIA THE INTERFACE BETWEEN ASSUMED AND ACTUAL NATURE OF PERCEPTIONS troublesome--typically with greater difficulty in determining the order in which the buttons would appear as targets and lesser difficulty in determining which buttons were targets.

Confusion and error would arise when I assumed the tension/vector perceptions were clairvoyant when in fact they were (say) clairvoyant and precognitive. To explain how this felt, refer back to Figure A-1. If the actual sequence of correct answers were Buttons B and D, and if I were assuming the perceptions were clairvoyant only, then it was not uncommon to have the perception that the intervening button (C) was the correct choice. The rationale for this perception was that it felt like a balance point between Buttons B (present target) and D (next target).

In retrospect, when I am more rationally aware of the room for error in the use of this cue mechanism, I am somewhat surprised as to how useful it was in operation.

It should be clear from the preceding descriptions that selections were made by a variety of processes which were used sometimes in isolation and oftentimes in combination. A typical sequence in the selection process was: (1) Check for "direct knowing" cues, if not there, then (2) Use "tension/vector" cues, then (3) Make final selection with "closure cues."

2. <u>Comments on Perceptual Processes</u>

Rather than work rapidly, I chose to work deliberately, consciously, and therefore slowly. I would typically take five to thirty seconds to select a button--enough time to have a firm and conscious sense of my internal cues and what I thought they meant. The typical sequence would be as follows:

- Clear mind and become quiet
- Concentrate internal awareness

- Observe various cues
- Rationally interact with cues to sort them out
- Select a button and press it
- Integrate feedback from response
- Clear mind and become quiet.

Except during "pattern recognition," when all buttons seemed equally accessible, I found that the top two buttons on the machine were much more accessible than the bottom two. Three plausible explanations emerge to account for this. First (and least likely I think) is a psychological predisposition against the bottom two buttons--perhaps because of the color of the buttons or because of the pictures associated with the targets. Second is the possibility that the circuitry of the ESP machine in some way favors the top two buttons or obscures the bottom two. Third (and most plausible to me) is the possibility that to the extent I used the "tension/vector" cue, then the bottom two buttons would be without a vector below them--making it more difficult to "bracket" the bottom two buttons with this perceptual process. In later phases of the experiment, I was more able to access the bottom two buttons and this seemed to correspond with increasing use of the "pattern recognition" cues and the decreasing use of tension/vector cues.

The longer I worked with the ESP machine, the more apparent it became that, in an extrasensory perception reality, time becomes fluid. In other words, although the experiment was designed to test clairvoyance (selecting the current target only, I found that the perceptual cues would oftentimes be equally applicable to precognition (selecting a future target--usually the next one). Therefore, making a correct selection required doing two things; first, finding the correct "pattern" of buttons that would be randomly selected by the machine (typically the pattern consisted of two to three buttons) and second, associating a time component with the buttons in that pattern. Stated differently, the same cues discussed above held equally well for precognition or for clairvoyance--so the problem of making a selection was compounded by the additional difficulty of having to determine whether a perceptual cue was associated with the button that had already been selected by the machine or the button that would be selected in the next or even subsequent trial. I definitely felt that if I could consistently separate clairvoyant from precognitive dimensions of identical cues, that I could substantially increase the accuracy of overall scores.

The cues were not always consistent in their presence and meaning. For example, I might be obtaining good results with the use of tension/vector cues and then find them becoming ambiguous, with a commensurate decline in my score. Then I would rely more heavily upon other cues. Or, the cues might work well for clairvoyant perceptions for a while but then shift to operate for precognition--then I would have to "recalibrate" myself to the cue mechanisms. So, it was a fluid, dynamic perceptual process which required flexibility and patience. Highly significant scores and perceptions seemed to go in spurts of ten trials or so, then I would fall back to a chance level until I could resynchronize myself with the machine and the character of my perceptual cues.

In the last phase of the experiment, I was allowed (according to protocol) to make use of practice runs. This seemed quite helpful for several reasons: First, it allowed me to reestablish rapport with the machine when the perceptual cues had obviously gotten out of synchronization with the pattern of machine generated selections; second, it allowed me more "free space" to try out new perceptual processes in the midst of an experiment and to see which of the old ones were most operable; and finally, it allowed me to "clear" a habituated perceptual pattern.

I tend to agree with the notion that it might be more appropriate to call these processes "extraconceptual perception" rather than "extrasensory perception." The perceptual cues were definitely present and they had sensory dimensions even though they do not fit into our traditional sensory categories. Just "where" and "how" these sensory cues were present is not clear to me--but these are essentially conceptual rather than sensory issues.

3. Problems in Perceptual Translation

A basic problem in using the ESP machine was not so much the obtaining of perceptual data as the translating of those data into sufficient information to allow the action of selecting the correct button. While the act itself is so simple as to be trivial, the information processes (gathering, filtering, dynamically translating) underlying that act seemed to me very substantial. It is within this unseen and unrecorded portion of the ESP testing process that most of the "action" takes place. From this vantage point I would like to suggest two impediments that might partially account for relatively low scores.

First, I am still not fluent in the "language" of extrasensory perceptions--analogously, it is like hearing many separate commands in Russian (or another unfamiliar language), each time spoken in slightly different ways and with different intonations and inflections. The call for action may be clearly heard but the translation of that command into operational reality is an imprecise process until the language can be better understood.

Second is the problem created by shifting back and forth between rational and intuitive knowledge processes during the course of the experiment. In selecting a single button I would use intuitive knowledge processes for perception and oftentimes, rational or semirational knowledge processes to interpret those perceptions. This is not to say that the rational component is absolutely necessary, but it did seem to be useful for me. In any event, since the experiment covers thousands of trials (button selections) it required thousands of translations from one knowledge mode to another. Although the rational mode did seem helpful for interpretation, it was also "costly" (i.e., by shifting to a rational mode, I could be thrown slightly off-balance in maintaining contact with the subtle and delicate intuitive processes--thereby introducing an additional element of ambiguity and error).

Related to the problem of differential knowledge processes is the problem of having to translate between states of consciousness in order to act upon extrasensory perceptions. LeShan* analyzed the experiential properties of what he has termed Clairvoyant Reality and found that while certain events (such as telepathy, precognition, and clairvoyance) are "normal" to this reality, certain other events (such as being able to take directed action toward a goal) are "paranormal." For me this was manifested experientially as the feeling that when I obtain extrasensory perceptions, I am so much a part of, and immersed in the Clairvoyant Reality that in order to act, I must causally separate myself from the Clairvoyant Reality and enter the dualistic, subject/object Reality that LeShan terms "Sensory Reality." Encouragingly, the "pattern recognition" process seemed to offer a means of both perception and action, which did not require the same degree of transfer between these subtly different states of consciousness.

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*Lawrence LeShan, The Medium, The Mystic, and the Physicist (Viking Press, New York, 1974).

The preceding points suggest that one difficulty in testing and assessing extrasensory perception may be the apparent need to translate it into an output that is not isomorphic with the perceptions themselves--a person must translate the perceptual "language" to a familiar form, across rational and intuitive dimensions, and relatedly, from one state of awareness to another. Is it possible, then, that our means for testing ESP may not be highly congruent with the nature of the phenomenon, and this may inherently reduce the significance of the test results that can be obtained?

4. Two Views of the ESP Process

I suspect that, to an external observer, my work with the ESP machine might appear as fairly consistent scoring slightly above chance--the logical inference could then be made that a small amount of extrasensory perception was mixed with a substantial amount of pure guessing. While the scoring data may support this inference, my awareness of the input process does not. Consider the following: on the first run, a person could get six "hits" out of twenty-five by pushing buttons at random; then on the second run, he could get six "hits" out of twenty-five by using extrasensory perception. To the statistician who looks only at the output, the scores are identical--they are no more than would occur by chance--and the logical inference would be that the input processes were identical or at least very similar. However alike they might appear externally, internally they could feel like quite different runs. In the second instance, the chance level of scoring would be the result of an imperfect but operative extrasensory perception process. Obviously, then, measurement of ESP by statistical output alone obscures the nature and extent of the extrasensory input. A relatively modest score on the ESP machine can--I think--substantially understate the amount of learning and perceptual development that actually occurs. The foregoing is consistent with my impression that my scores, though statistically significant, still did not reflect the actual amount of learning that had occurred.

5. Comments on the Research Phases

Phase I (ESP machine with paper printout)--As I mentioned earlier, this was a substantial learning period where I was finding out which perceptual cues were valid and which were not. In this phase the experiment was still new and interesting, and I had very few performance expectations for myself.

Phase II (ESP machine with remote paper printout plus teletype hookup)--After the significant scores obtained during Phase I, and with preliminary learning established, this was a frustrating test phase with consistently low scores (at the chance level). I could find no rational reason why my scores should decrease. Subjectively, however, it seemed to me that the machine had taken on a different character as it "interacted" with the teletype: In other words, the ESP machine seemed less "personable," more "isolated," and my perceptual cues were less synchronized with the actual workings of the machine.

Phase III (ESP machine with no form of printout but with observer present)--Initially, this presented a new learning situation since my confidence had been diminished by Phase II and the presence of an observer increased my performance expectations--which inhibited the clarity of my perceptions. In a short time, though, I became acclimated and felt very good about the experiment and presence of an observer.

6. Supportive Mind Set

There emerged, after a time, what seemed to be a series of pre-conditions to good performance in terms of mind set. These were:

- A high level of motivation seemed essential. The task of pushing one of four buttons over thousands of trials could be rather boring--enough to allow one's attention to wander. With each trial, it was necessary to have a high level of motivation to ensure adequate levels of concentration and focused attention.
- Although motivation, concentration, and attention were important, it was also necessary not to be too concerned with the success or failure associated with each selection. If I became "attached" to the outcome of a previous trial, whether a success or a failure, it could divert a significant amount of attention from the present trial. Therefore, each trial must be separate/fresh/clear/unconditioned by the actual success or failure of previous trials and separate from the imagined successes or failures of upcoming trials.
- A relatively stable, undisturbed emotional state also seems important. I noticed the most substantial fluctuation in my scores when I was emotionally stressed (angry, hassled, and so on).
- Feeling rested physically also seemed important. This was particularly true if I were to work with the machine for an hour or two--as this required a substantial amount of energy.
- A positive attitude--a feeling that I could do well and could always score at least at the chance level--was also important. A corollary to this was that I found I did better when I "always liked myself" even if I did poorly. Self-deprecation seemed to be a sure way of rapidly diminishing the accuracy of the perceptual processes.

7. The Environment

There were attributes of the surrounding environment that seemed to enhance the accuracy of my selections. The more significant factors seemed to be the following:

- It was helpful to have a relatively quiet working environment. Or, if there were noises, to have them of a sort--fairly constant ones that remained in the background--that could be readily filtered out of my consciousness. My impression was that external sensory information--particularly sounds--could readily overload/override subtle and delicate internal sensory information.

- It also seemed to help to have low light levels--I would always turn out the overhead lights in the testing room. I experimented with closing my eyes to further reduce external sensory stimulation and I found that this would increase the sensitivity of sensory cues, but this increase in sensitivity was offset by a lack of visually based feedback to verify the accuracy of the selections. As a consequence, I chose to keep my eyes open.

- I found it essential to work with the ESP machine by sitting somewhat above it so that I could look down on the face of the machine. For some reason, perceptual discrimination seemed much more difficult when I would sit at a lower level which placed the buttons in a plane more nearly horizontal to my face and upper body.

8. <u>Transferability of Processes</u>

The perceptual learning gained in this experiment seemed generally transferable to other situations where I might use ESP abilities, in particular, telepathy, precognition, and clairvoyance. The inference is that a process or faculty is being developed which has numerous applications in other situations which would rely upon ESP. Analogously, just as jogging could exercise muscles to make a person more adept at playing football, dancing, swimming, and the like, the use and development of these "psychic" muscles seems to have some degree of transference to other situations.

9. Conclusions

I found the experiment to be a very substantial learning experience in which, I feel, I learned much more than was reflected in the scores. It allowed me to begin to identify an ability which I presume was largely latent within--never having had a prior opportunity for overt expression. Finally, it suggests to me that this must be a common ability among many people that they simply do not recognize--primarily because they have never had the opportunity to explore it as a legitimate and "real" phenomenon.

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