Target and Sender Dependencies in Anomalous Cognition

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I. OBJECTIVE

There are two objectives of this pilot study:

(1) Explore the effects of target properties on AC quality.

(2) Determine the degree to which anomalous cognition (AC) quality depends upon a sender.*

* Definitions of terms can be found in Section V (i.e., Glossary) on page 14.

II. INTRODUCTION

The field of parapsychology has been interested in improving the quality of responses to target material since the 1930's when J. B. Rhine first began systematic laboratory studies of extra sensory perception. Since that time, much of the field's effort has been oriented toward psychological factors that may influence anomalous cognition (AC). In this section, we review the pertinent literature that describes attempts to improve the quality of AC by categorizing target content.

At a recent conference, Delanoy reported on a survey of the literature for successful AC experiments, and, she categorized the target material according to perceptual, psychological and physical characteristics.[1*] Except for trends related to dynamic, multi-sensory targets, she was unable to observe systematic correlations of AC quality with her target categories.

Watt examined the AC-target question from a theoretical perspective.[2] She concluded that the "best" AC targets are those that are meaningful, have emotional impact, and contain human interest; those targets that have physical features that stand out from their backgrounds or contain movement, novelty, and incongruity are also good targets.

The difficulty with either the survey of the experimental literature or the psychologically oriented theoretical approach is that understanding the sources of the variation in AC quality is problematical. Using a vision analogy, sources of visual material are easily understood (i.e., photons); yet, the percept of vision is not well understood. Psychological and possibly physiological factors influence what we "see." In AC research, the same difficulty arises. Until we understand the influence of these factors on the AC percept, results of systematic studies of AC are difficult to interpret.

Yet, in a few cases, some progress has been realized. In 1990, Honorton et al. conducted a careful meta-analysis of the experimental Ganzfeld literature.[3] In Gansfeld experiments, receivers are placed in a state of mild sensory isolation and asked to describe their mental imagery. After each trial, the analysis was performed by the receiver, who was asked to rank order four pre-defined targets, which include the actual target and three decoys; the chance first-place rank hitting rate was 0.25. In 355 trails collected from 241 different receivers, Honorton et al. found a hitting rate of 0.31 ($z = 3.89, p \leq 5 \times 10^{-5}$) for an effect size of 0.20. In addition, he found that AC quality was significantly enhanced when the targets were video clips from popular movies (i.e., dynamic) as opposed to static photographs (i.e., effect sizes of 0.32 and 0.05, respectively). All trials were conduced with a sender.

In a carefully conducted meta-analysis, Honorton and Ferrari report significant hitting in forced-choice, precognition experiments.[4†] They analyzed 53 years of experiments conducted by 62 different investigators using a limited set of symbols (i.e., called Zener cards) as target material. Fifty thousand

* References may be found at the end of the document.

† Forced-choice means targets are randomly chosen from a known and limited set of possibilities (e.g., red or black playing cards). Precognition means that the target is generated randomly *after* the guess has been registered.

subjects contributed a total of approximately 2×10^6 individual trials. The overall effect size was 0.020 corresponding to a p-value of 6.3×10^{-25}. Similarly, in an earlier review article, Honorton analyzed 7.5×10^5 forced-choice Zener card trials that were collected from 1934 to 1939 and found a significant overall effect size of 0.016 ± 0.001.[5]

Puthoff and Targ publish the results of 39 AC real-time trials where the targets were natural scenes in the San Francisco Bay area.[6] The effect size for the 39 trials was 1.15.

Table 1 summarizes these results for each target type:

Table 1.

Effect Size as a Function of Target Type

Target Type	Trials	Effect Size
Symbols (Real-Time)	7.5×10^5	0.016 ± 0.001
Symbols (Precognitive)	2.0×10^6	0.020 ± 0.001
Static Photographs	165	0.05 ± 0.08
Dynamic Photographs	190	0.32 ± 0.07
Static Natural Scenes	39	1.15 ± 0.16

The effect sizes shown in Table 1 are qualitatively monotonically related to target "complexity;" yet an appropriate quantitative description for target type is currently unknown. Yet, target "complexity" was one of the experimentally observed and theoretically conceived target concepts found by Delanoy and Watt, respectively.

A number of confounds exist, however, in this database for the effect-size measures. For example, in all but the Puthoff and Targ study (i.e., targets were natural scenes), the receivers were unselected. That is, they did not participate in the various experiments on the basis of their known ability as receivers. So, is the large effect size for the Puthoff and Targ study because of the accomplished receivers, the natural-scene targets, or some combination of both? While there are a number of other exceptions, the preponderance of the data were from unselected individuals. In many of the trials, a sender was concentrating on the target material, and as in most perception experiments, psychological factors and boredom contribute to the variance in the effect sizes.

In this pilot experiment, we will apply one physical measure to static and dynamic photographs to quantify the relationship between target type and AC quality. By careful selection of target content, we will minimize the psychological factors in perception. In addition, we will minimize individual differences by conducting many trials with each receiver and by only choosing receivers who have previously demonstrated excellent AC skill.

Because the previous database included trials with and without senders, we will explore the effects of a sender on AC quality, as well.

III. APPROACH

1. Target-pool Selection

The static target material for this pilot study will be an existing set of 100 *National Geographic* magazine photographs. This set has been divided into 20 sets of five photographs that were determined to be visually dissimilar by a fuzzy set analysis.[7] The dynamic target material will be approximately 50, 60 to 90 second clips from popular video movies. These clips will be selected because they:

- are thematically coherent,
- contain obvious geometric elements (e.g., wings of air craft), and
- are emotionally neutral.

The intent of these selection criteria is to control for cognitive surprise, to provide target elements that are easily sketched, and to control for psychological factors such as perceptual defensiveness.

The video segments will be drawn from a variety of themes including adventure, documentary, and fantasy.

2. Target Preparation

The target variable that we will consider in this experiment is the total change of entropy per unit area, per unit time. We have chosen this quantity because it is qualitatively related to the "complexity" of target type shown in Table 1, and because it represents a potential physical variable that is important in the detection of traditional sensory stimuli. In the case of image data, the entropy is defined as:

$$S_k = -\sum_{j=0}^{N_k-1} p_{jk} \log_2(p_{jk}),$$

where p_{jk} is the probability of finding image intensity j of color k. In a standard, digitized, true color image, each pixel (i.e., picture element) contains eight binary bits of red, green, and blue intensity, respectively. That is, N_k is 256 (i.e., 2^8) for each k, $k = r, g, b$. The total change of the entropy in differential form is given by:

$$dS_k = \nabla S_k \cdot \vec{dr} + \frac{\partial S_k}{\partial t} dt \,. \qquad (1)$$

We must specify the spatial and temporal resolution before we can compute the total change of entropy for a real image. Henceforth, we drop the color index, k, and assume that all quantities are computed for each color and summed.

2.1 Static Photographs

Each target from the pool of 100 *National Geographic* magazine photographs will be scanned at 100 dots per inch (dpi) for eight bits of information of red, green, and blue intensity. At 0.25 inch spatial resolution, for example, this scanning density provides 625 pixels for each 0.25×0.25 in^2 patch to compute the p_j.

For a specified resolution, the target photograph is divided into an integral number of macro-pixels excluding a thin border, if necessary. The entropy for the (i,j) macro-pixel is computed as:

$$S_{ij} = -\sum_{j=0}^{N-1} p_j \, log_2(p_j),$$

where p_j is computed empirically from the pixels in the (i, j) macro-pixel only. For example, consider the target photograph shown in Figure 1.

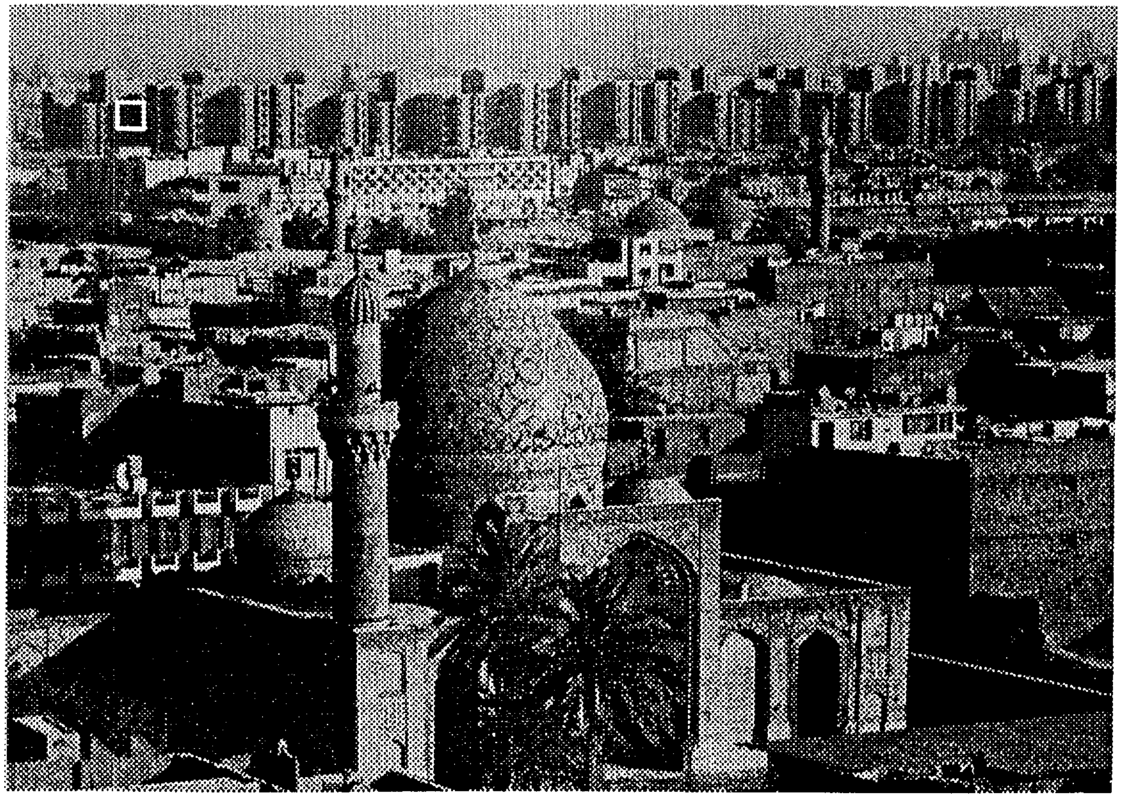

Figure 1. City with a Mosque

Figure 2 shows the probability density for green macro-pixel (3,3), which is shown as a white square in the upper left hand corner of Figure 1.* The probability density and the photograph indicates that most of the intensity in this patch is near zero value (i.e., no intensity of green in this case). In a similar fashion, S_{ij} are calculated for the entire scene. For the photograph shown in Figure 1, i ranges from zero to 43, and j ranges from zero to 32 for a total of 1,452 macro-pixels.

* The original photograph was 8.5×11 inches, and we have standardized on 0.25 inch resolution.

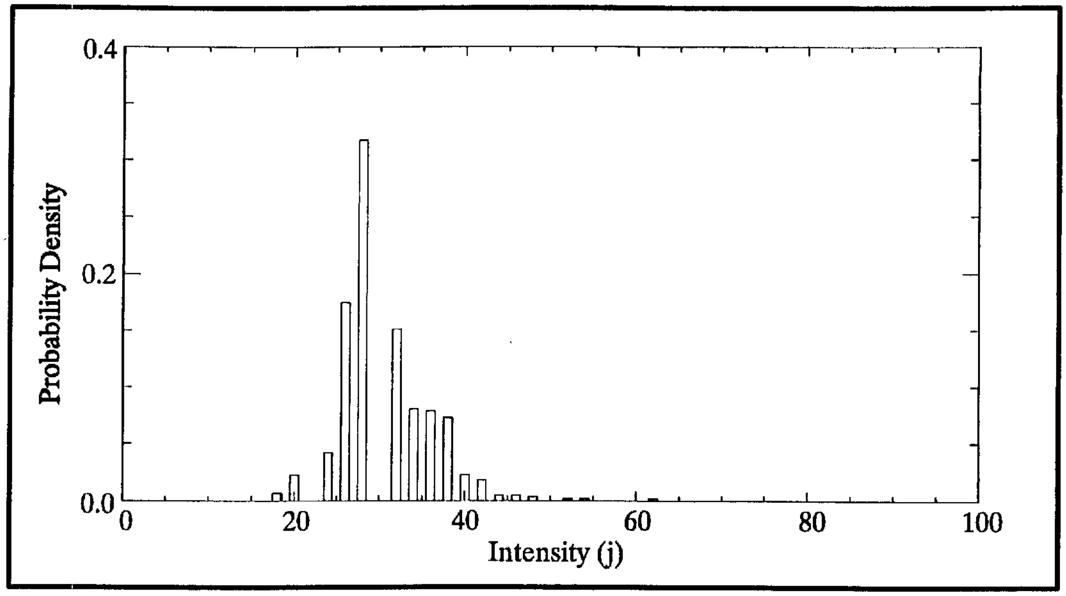

Figure 2. Green Intensity Distribution for the City Target (Macro-pixel 3,3).

We will use a standard algorithm to compute the 2-dimensional spatial gradient of these 1,452 values of the entropy. Figure 3 shows contours of constant change of entropy (calculated from Equation 1) for the city target. The total change per unit area is 1.98 bits/0.25 in^2.*

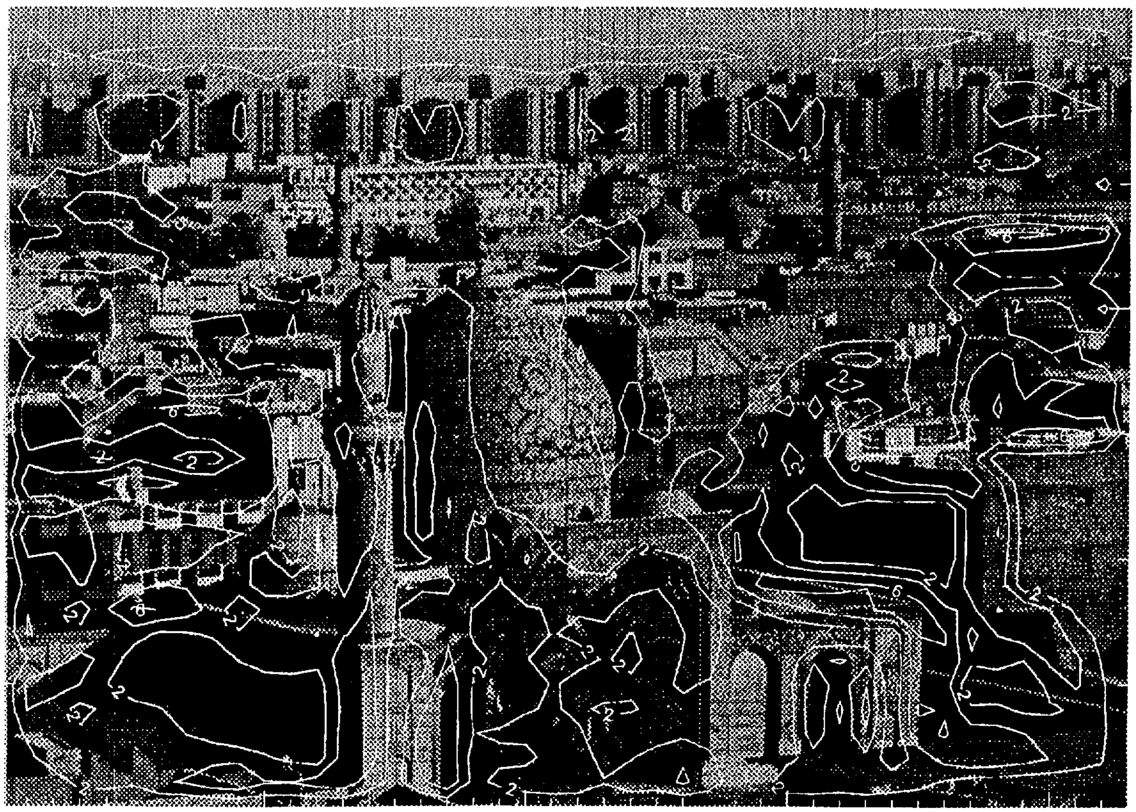

Figure 3. City with Mosque ($|\Delta S|$ = 1.98 bits/0.25 in^2).

* In this formalism, entropy is in units of bits and the maximum entropy is 24 bits.

The city target was chosen as an example because it was known (qualitatively) to be a "good" static photograph for AC trials in earlier research. Figure 4 shows contours of constant change of entropy for a photograph that was known not to be a "good" AC target.

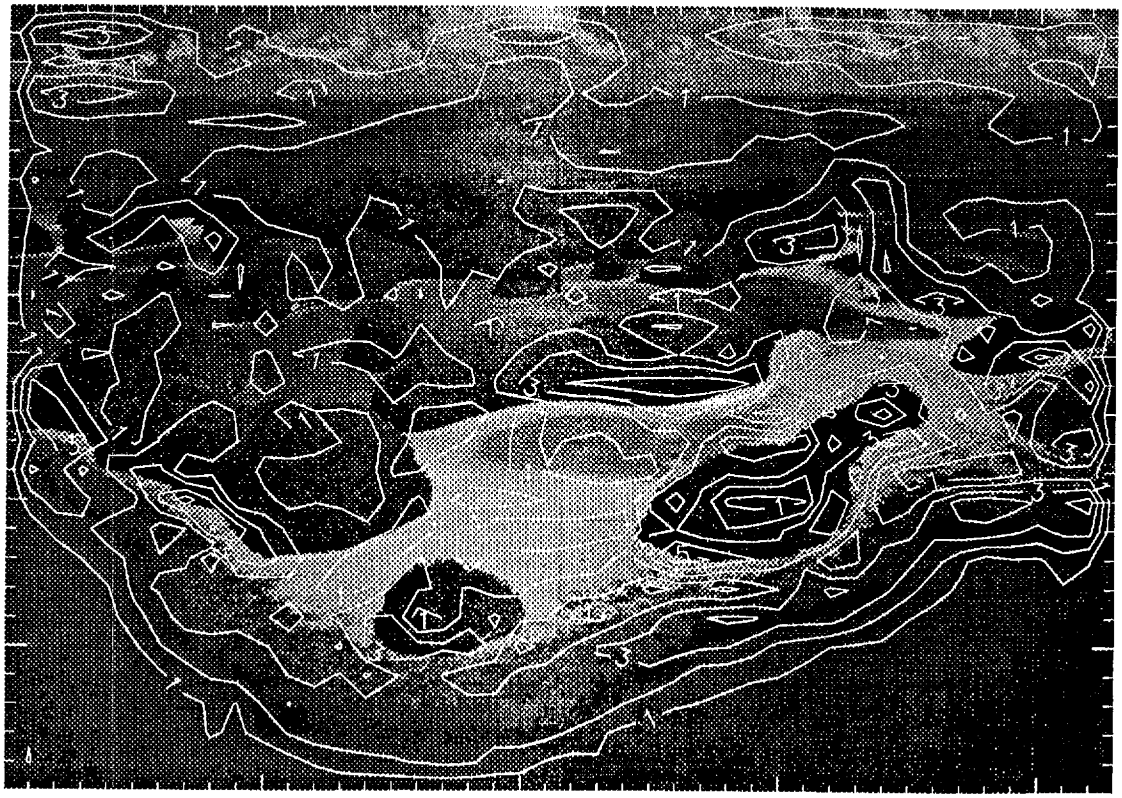

Figure 4. Pacific Islands ($|\Delta S| = 1.35$ bits/0.25 in^2).

For comparison, we show in, Figure 5, the traditional Zener card set, which was used in most of the forced-choice experiments shown in Table 1 and described above.

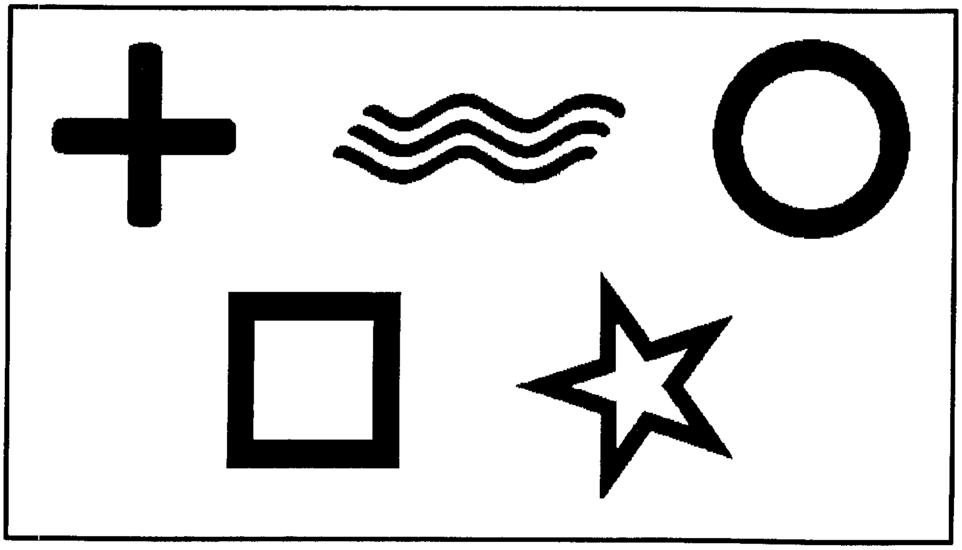

Figure 5. Zener Target Cards (Average $|\Delta S| = 0.15$ bits/0.25 in^2).

In Table 2, we modify Table 1 to show the values of ΔS $(0.25\text{ in})^{-2}$ for two of four target types.

Table 2.

Potential Correlation of ΔS with Effect Size

Target Type	ΔS $(0.25\text{ in})^{-2}$
Symbols	0.15
Static Photographs	1.35
Dynamic Photographs	?
Static Natural Scenes	?

We illustrate in this table the intent of this pilot study. We will compute ΔS for all the static and dynamic targets and, using accomplished receivers, measure their associated AC effect sizes.

2.2 Dynamic Photographs

The total change of entropy for the dynamic targets will be calculated in much the same way. The video target will be digitized at approximately one frame per second. The spatial term of Equation 1 will be computed exactly as it was for the static targets. The second term, however, will be computed from differences between adjacent frames. Or,

$$\frac{\partial S_{ij}}{\partial t} \approx \frac{\Delta S_{ij}(t)}{\Delta t} = \frac{S_{ij}(t + \Delta t) - S_{ij}(t)}{\Delta t}, \qquad (2)$$

where Δt is the one over the digitizing frame rate. We can see immediately that the dynamic targets will have a larger ΔS than do the static ones becuase Equation 2 is identically zero for all static targets.

2.3 Cluster Analysis

As a result of the above calculations, the static and dynamic target sets will have associated sets of ΔS. Using standard cluster analysis, each set will be grouped into relatively orthoginal clusters of relatively constant ΔS. Inspection and fuzzy set analysis will be used to construct packets of five *visually* dissimilar targets from within each cluster. Since we do not yet know how to assign entropy to an AC response, the AC analysis must be performed on the basis of visual discrimination.

3. Target Selection

For a specified target type (e.g., static photographs), a target pack will be selected randomly and one target of the five within the that pack will also be chosen randomly.

4. Receiver Selection

Six experienced receivers, who have produced significant AC effect sizes in previous investigations, will contribute 40 AC trials each. Each receiver will contribute ten trials in each of the conditions shown in Table 3.

Table 3

Experiment Conditions

Condition	Target Type	Sender
1	Static	Yes
2	Static	No
3	Dynamic	Yes
4	Dynamic	No

5. Sender Selection

The sender for all trials will be the principal investigator (PI).

6. Session Protocol

Before the pilot experiment begins, the experiment coordinator will generate, randomly, a counter balanced set of 20 dynamic and 20 static targets and, within each target type, generate randomly a counter balanced set of sender/no sender conditions. Each of the six receivers will have their own individual set of targets/conditions. For each receiver, the experiment coordinator will prepare 40 sealed envelopes containing the target number and condition for each trial. For the no-sender condition, the target number will be sealed in a smaller internal envelope so that the PI will remain blind to the target choice, but in the sender condition, the target number is visible in the outer envelope. The receivers will be notified about the dates and times of day when their individual targets are available.

For each trial and for each receiver, the PI will perform the following tasks:

- Determine from the above list, the target and sender condition.
- In the sender condition, study the selected target and attempt to "transmit" it to the intended receiver. In the no-sender condition, do nothing
- At the conclusion of the 15 minute trial period and after the receipt of the receiver's response by facsimile, send a copy of the target material (i.e., either a photograph or video tape) to the receiver by over night mail.

During each trial, the receiver will perform the following tasks:

- At a prearranged time, the receiver will find a quiet and lighted room in his or her home and sit at a desk.
- For a period lasting no longer than 15 minutes, the receiver will write and draw his or her impressions of the intended target material, which will be located in Lititz, PA.
- At the end of the AC trial, the subject will send the response by facsimile to the principal investigator (PI).
- By overnight mail, the subject will receive a copy of the actual target as feedback for the trial.

We will not provide specific instructions beyond logistical information to the receivers, because they are all experienced in this type of task.

For each receiver, the 40 trials will occur at a rate of three per week (i.e., one every other day) during a five-month period beginning in January 1992. There will be significant breaks during this period for holidays and to allow the receiver to participate in other experiments. The PI will maintain frequent phone contact with them during the experiment.

At the end of the study, the PI will remove the receiver's name, date, and time from each response; randomize the order within a receiver set; and provide an analyst with a set of responses and associated target packs. The indented target within each pack will not be disclosed.

7. Analysis

For each trial, there is a single response and its associated target pack (i.e., either static or dynamic). During the first part of the analysis, a judge, who is blind to the condition and target for the trial, will be asked to rank-order the targets within the given pack. This is a forced rank, so regardless of the quality of match between the response and targets within the pack, the judge must assign a first place match to the response, a second place match to the response, and so on for each of the five targets. The output from this part of the analysis is a rank-order number (i.e., one to five, one corresponding to a first place match) for the correct target.

For each receiver, target type, and condition there are 10 such rank-order numbers that constitute a block of data. A rank-order effect size will be computed for a block as:

$$\varepsilon_{ij} = \frac{\overline{R}_{ij} - \overline{R}_0}{\sqrt{\frac{N^2-1}{12}}}, \tag{3}$$

where $\overline{R}_{ij}$ is the average rank for target type i and sender condition j, and $\overline{R}_0$ is the expected average rank, which for this study is equal to three for all cases. In Equation 3, N is the number of possible ranks and is equal to five throughout this study. Thus, Equation 3 reduces to:

$$\varepsilon_{ij} = \frac{\overline{R}_{ij} - 3}{\sqrt{2}}.$$

During the second part of the analysis, a two-way analysis of variance (ANOVA) will be computed for each receiver. The main effects are target type and sender condition.

In this part of the analysis, we do not plan to combine data across receivers.

In the third part of the analysis we will construct a scatter diagram of rank-order number versus ΔS. Using a logistic transformation on the rank-order numbers, we will compute a linear correlation coefficient to determine the degree to which AC quality linearly depends upon ΔS. By inspection of the scatter diagram, we will determine if higher-order correlations should be calculated.

8. Hypotheses

8.1 Null Hypothesis

The overall null hypothesis is that ε_{ij} will not be significantly different from zero. Even with only 10 trials in each condition and given that the historical effect size of many of the receivers is approximately 0.8, there is an 80% chance of observing a significant effect size for a given block of data.

8.2 Sender and Target Condition

Using an F-test we will test the hypothesis that the quality of AC does not depend upon a sender regardless of target type. Similarly, we will use an F-test to test the hypothesis that the quality of AC does not depend upon target type regardless of the sender condition.

The interaction terms in the ANOVA will test the hypothesis that a sender might improve AC quality for only a specific target type.

8.3 Target Entropy

The AC quality of each trial is assessed within a given target type and as closely as possible with similar ΔS. Thus, a significant correlation between target ΔS and AC quality will be a valid indication of the primary hypothesis that they are linearly related.

IV. DISCUSSIONS AND CONCLUSIONS

In this pilot investigation we will study the degree to which the change of target entropy affects the quality of anomalous cognition, and we will explore the relationship of a sender to the AC process. There are a number of potential outcomes to this investigation and a number of post hoc analyses that could yield productive insight. We discuss these outcomes and analyses below.

1. Null Result

At the 95% confidence level, no statistically significant deviations are observed for any of the block effect sizes, ε_{ij}. If a X^2 test for homogeneity of effect sizes across receivers demonstrates that the data are homogeneous (i.e., $p(X^2) > 0.05$), then we conclude that the experiment failed to demonstrate significant AC functioning. In this case we will recommend that a replication be conducted with more trials, because there is a 20% chance the the data produced by a single receiver would not reach statistical significance *even* if an alternate hypotheses was true. That is, the Type II error is 20%.

If, however, the effect sizes across receivers is *not* homogeneous (i.e., $p(X^2) \leq 0.05$), then the data for each receiver will be examined individually. Depending upon available resources and the advice of the SOC, the receivers who may have demonstrated individually significant results might be asked to contribute additional data.

2. Significant Deviations

The are a number of different ways, in accordance with the analysis described above, that significant deviations could be observed.

2.1 Dependency on Target Type

Suppose that the ANOVA demonstrates significant effects for the target type regardless of the sender condition. Suppose further that we observe a significant correlation between ΔS and AC quality. In this case, we would consider that the primary hypothesis (i.e., the change of target entropy is sensed by AC) has been confirmed. We would recommend that we extend the study to include natural scenes as target material. To do this properly, however, we must estimate the potential change of thermodynamic entropy for real locations.

2.2 Dependency on Sender

If the ANOVA demonstrates significant effects in support of a sender regardless of target type and there is no significant interaction terms between target type and sender condition, we would conclude that a sender can significantly improve the quality of AC. Furthermore, we would conclude, as Delanoy before us, that we still do not understand what constitutes an AC target.

We would recommend, therefore, that a post hoc analysis be conducted to search for target systematics in the existing database. If any were found, we would formulate hypotheses to be tested in later studies.

2.3 Other Post Hoc Analyses

Depending upon time and resources, we will re-analyze the AC data. Decoy targets for the blind ranking would be selected not on the basis of constant ΔS, but rather on a visual basis alone; this is the traditional method usually employed in AC studies. Depending upon the content of the targets, there might be other dimensions that could be used to construct decoy targets (e.g., function, physical proximity of target elements).

There has been some indication in the literature that AC quality depends weakly upon the noise in the geomagnetic field. Since we routinely record the time, date, and location of each trial, we will add the results from this experiment to that analysis.

V. GLOSSARY

Not all the terms defined below are germane to the MEG study, but they are included here for completeness. In a typical anomalous mental phenomena (AMP) task, we define:

- Anomalous Cognition—A form of information transfer in which all known sensorial stimuli are absent. That is, some individuals are able to gain access, by as yet an unknown process, to information that is not available to the known sensorial channels.
- Receiver—An individual who attempts to perceive and report information about a target.
- Agent—An individual who attempts to influence a target system.
- Target—An item that is the focus of an AMP task (e.g., person, place, thing, event).
- Target Designation—A method by which a specific target, against the backdrop of all other possible targets, is identified to the receiver (e.g., geographical coordinates).
- Sender/Beacon—An individual who, while receiving direct sensorial stimuli from an intended target, acts as a putative transmitter to the receiver.
- Monitor—An individual who monitors an AC session to facilitate data collection.
- Session—A time period during which AC data is collected.
- Protocol—A template for conducting a structured data collection session.
- Response—Material that is produced during an AC session in response to the intended target.
- Feedback—After a response has been secured, information about the intended target is displayed to the receiver.
- Analyst—An individual who provides a quantitative measure of AC.
- Speciality—A given receiver's ability to be particularly successful with a given class of targets (e.g., people as opposed to buildings).

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APPENDIX

This appendix contains the full reprints of the following seven papers:

(1) Characteristics of Successful Free-Response Targets: Experimental Findings and Observations
(2) Characteristics of Successful Free-Response Targets: Theoretical Considerations
(3) PSI Communication in the Ganzfeld
(4) "Future Telling:" A Meta-analysis of Forced-choice Precognition Experiments, 1935-1987
(5) Error Some Place!
(6) A Perceptual Channel for Information Transfer over Kilometer Distances: Historical Perspective and Recent Research
(7) Advances in Remote-Viewing Analysis

CHARACTERISTICS OF SUCCESSFUL FREE-RESPONSE TARGETS:
EXPERIMENTAL FINDINGS AND OBSERVATIONS

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Abstract

This paper reviews experimental findings and observations concerning characteristics of successful free-response targets. Information relevant to the following categories of target characteristics was examined: colour/black and white; complex/simple; novel/familiar; abstract/concrete; dynamic/static; form/idea and meaning; emotion; and theme/content. Very few conclusions could be drawn from the data base, although a tentative finding related dynamic, multi-sensory targets to ESP success. Other suggestive findings were reported for novel and abstract characteristics. The discussion considers possible reasons for the general lack of findings and presents a possible avenue for future research.

ACKNOWLEDGEMENTS: Ms. Caroline Watt and Professor James Crandall contributed substantially to the research for this paper, for which I am most grateful. My thanks also to Dr. Julie Milton and Ms. Watt for helpful comments on the paper's content and again to Ms. Watt for the typing of the references.

This and the following paper, presented by Caroline Watt, represents the findings of a literature review examining what makes a successful (in terms of being accurately perceived by the percpient) and/or unsuccessful free-response GESP target. The review was undertaken to assist the Koestler Lab in constructing a free-response target pool for use in our future research. We thought such a review was necessary as initial discussions as to what type of targets we should be looking for revealed that various researchers in our group held differing opinions/ideas as to what qualities a successful target should have. These differences were further reinforced when we started discussing various targets which we had used in our own independent research, and those of other researchers with whose targets pools we were familiar. An initial search through some of the major parapsychology journals and source books revealed very little coherently arranged information regarding free-response targets. This review was undertaken in an attempt to remedy this situation. To this end, we examined relevant parapsychological and psychological experimental findings and theoretical models, post hoc observations, and lab lore in hopes of discovering some consensus regarding psi-conducive target qualities and materials. This first paper will present the findings from parapsychological experimental findings, including post hoc findings and anecdotal observations.

It should be stressed that this review is not meant to be exhaustive. We have tried to scout out related information in the main journals and newsletters (Journal of the American Society for Psychical Research, Journal of Parapsychology, Journal and Proceedings of the Society for Psychical Research, European Journal of Parapsychology, International Journal of Parapsychology, Parapsychology Review, and Research Letter). We have also examined various conference proceedings (Parapsychological Association and Parapsychology Foundation), major parapsychological source books, some of the popular literature regarding the development of psychic abilities, some of the related psychology literature, and other prominent books in our field which we thought likely to contain the information we were seeking. However, it was obviously impossible to examine all of the possibly related literature. Our survey of the historical literature was necessarily quite limited (in fact we examined only two main sources, Warcollier's writings and Phantasms of the Living, 1886).

Target-related information from forced choice studies has not been systematically considered here, the primary reason for this omission being the two reviews of this literature already conducted by Palmer (1978) and Carpenter (1977). However, general findings from these sources occasionally will be referred to where appropriate in this review.

The most frequent comments regarding targets found in these sources were generalizations regarding the choice of target material. For example comments might be made that targets were chosen which were vividly coloured, intrinsically interesting, pleasant, and so on. While such comments may be viewed as conveying the experimenters' perspective of what constitutes an easy-to-perceive target, to list all such comments would have been a very tedious task for both the author and her audience. Furthermore, no comment could be made upon the utility of whatever parameters were adopted when choosing targets unless one were to attempt a meta-analysis of the relevant studies, a project which was far beyond the scope of the present undertaking. Thus, such comments were not included in this review unless information was provided which related particular target characteristics to the success or failure of the study, and/or the target materials were specifically chosen to be unusual in some respect, with [illegible]

The initial task in this undertaking required finding some way to organize the target information in a meaningful and useful manner. This proved to be quite problematic, as target materials and content are seldom one-dimensional. Thus it was required to find a means of categorizing a diverse range of target materials, such as film clips, actual geographical sites, agents' experience of some sensory stimulus, and a large range of assorted pictorial material, each representing varying degrees of denotative and connotative complexity. Indeed, even defining the target in many studies was not a straight-forward proposition. For example, in telepathic designs, is the target the agent's experience of the target material or the target material itself?

In approaching this task it was thought that the target information could perhaps be divided according to the type of target material used (e.g. art prints, film clips, geographical locations, etc.). However, this approach was rejected as in many cases there was not enough available information about a specific target material to allow sensible generalizations to be made. Also explored were various ways of trying to represent and categorize the obtained target information in a multi-dimensional manner, taking into account both denotative and connotative meaning. To this end, attempts were made to apply to the data various three-dimensional conceptualizations of the sort obtained from the semantic differential. Thus, we sought to find one scale which would categorize the obtained target information taking into consideration various connotative components such as evaluation (does the information convey something which is good-bad, clean-dirty, sacred-profane, etc.), potency (weak-strong, powerless-powerful, light-heavy, etc.), and activity (fast-slow, active-passive, sharp-dull, etc.). This approach of organizing the data was rejected as there was not enough information about most targets to justify a post hoc fitting of the obtained information into such a model. Thus, in the end the task was necessarily defined by the type of information obtained in the literature search.

Looking through the data obtained, it was decided that the information could best be organized according to the following target characteristics: colour / black and white; complex / simple; novel / familiar; abstract / concrete; dynamic / static; form / idea and meaning; emotion; and theme / content. The "working definitions" of these categories will be delineated in the following appropriate sections of this paper. There were many instances where the same data fitted into several different categorizations. For instance, in Krippner, Ullman, et al. (1972) the target consisted of a randomly chosen word, an art print which portrayed the word, and then a multi-sensory (auditory, gustatory, olfactory, tactile and kinesthetic) environment relating to the word/picture was created for the agent. Such a target could easily be classified as complex, novel, dynamic, emotional, and as having a strong theme. In such situations, the author has attempted to refer to the information in all the relevant categories, but has only provided details of the study in the category where it was first mentioned.

<u>Colour / Black and White</u>

The colour category referred to all target materials which were coloured, as opposed to black and white. A telepathic dream study by Krippner and Zeichner (1974) obtained a significant degree ($p < .002$) of psi-hitting using 74 art prints as the targets. A descriptive analysis of the art prints was then performed using an adapation of Gough and Heilbrun's Adjective Check List. Three judges evaluated each of the art prints using this list. If two judges checked the same adjective for any picture, that adjective was deemed to describe the particular print. This analysis revealed that a higher percentage of hits were associated with targets which had blue in them, where targets containing orange and yellow were associated with more misses (whether results were significant is not reported). Puthoff and Targ (1979), in an anecdotal comment upon their remote viewing studies stated that most hits were associated with various nonanalytic aspects of a target, such as colour. However, in another remote viewing study (Targ, Targ and Lichtarge, 1986) where colour was superimposed over black and white slides of locations, it was found that the viewers were unable to perceive the colour. In commenting upon these results the authors speculated that the lack of colour perception may have been due to the restricted number of colour choices which resulted in making the colour perception a more analytic task than the free-response perception of possible target sites. Much of Warcollier's (1938) work used simple black and white line drawings as targets. However, he observed informally that when colour was in the target, it appeared to be perceived as frequently as was the form of the drawing.

A non-psi study by Braud, Davis, and Opella (1985) examined the frequency of occurrence of different types of imagery in dreaming and ganzfeld states. As this study used no targets, the results could indicate what types of imagery have an a priori probability of being mentioned more often than others. In relation to this category, they found that dreaming and ganzfeld imagery contain a predominance of colour (among other things). These results could be pertinent to the findings discussed in this paper, in that some of these findings could be due to a simple predominance of certain naturally-occurring types of imagery as opposed to reflecting actual transmission of target-related content. It is possible that the higher frequency of colour imagery in general could lead to spurious observations of success with colour targets unless formally examined. This should be borne in mind when considering anecdotal observations.

Many studies have been conducted using black and white targets, most notably those experiments where the target consisted of simple line drawings. However, we found no free-response work which compared the effectiveness of black and white to coloured targets. McMahan and Rhine (1947) conducted a forced-choice study using both coloured and black and white Zener cards. They found a higher average score with the coloured cards than with the black and white, but the difference was not significant.

The findings from this category do not indicate any clear-cut differences between the success-rate of colour and black and white target materials. As both have a long track-record of obtaining significant psi outcomes, research specifically aimed at comparing the two in a free-response setting would be needed before any conclusions regarding the superiority of one over the other could be made.

Complex / Simple

Information included in the "complex" category referred to comments and findings about target materials, most commonly pictorial, which were complex and/or rich in content. Krippner and Zeichner (1974) found a higher percentage of misses with more complex targets (whether the finding was significant was not reported). Stuart (1946b) stated that reasonably complex target material might mislead subjects. Krippner (1970) expressed concern that complex targets would mislead not the subjects but the judges, as complex targets could make the evaluation procedure overly problematic, with the creative judge finding numerous correspondences between many dream sequences and complex, detailed pictures. On the other hand, significant results have been obtained with very complex target material such as film clips (Psychophysical Research Laboratory, 1985) and the multi-sensory target environment of Krippner, Ullman, et. al. (1972) described in the introduction.

Information classified as "simple" included references to targets composed of clear, unequivocally definable, common objects and symbols. Most frequently these targets were simple line drawings. Both Carington (1940) and Stuart (1946a) recommended the use of simple, as opposed to compound, drawings so as not to confuse the subject. Warcollier (1963) noted that even though his targets were simple, percipients' responses still showed considerable distortion. As above, Krippner and Zeichner (1974) found a higher percentage of hits associated with more simple targets as measured by the number of adjectives used to describe the target (again, whether this finding was significant is not reported).

Several forced choice studies have examined the use of multiple-aspect targets. Generally these targets would be considered to be 'simple' by free-response standards. However, being multi-aspect by definition, they would represent more complex material than many forced-choice targets. Palmer (1978) in reviewing this work concluded that when multiple-aspect targets were used subjects tended "to score at least as high or higher on the total target than on any of its primary attributes. Such results suggest either that such targets are perceived holistically (even if the overt responses are fragmentary) or that a correct guess on one attribute somehow facilitates correct guesses on other attributes."(Palmer, 1978, p.88) In a review of six studies utilizing dual-aspect targets, Kennedy (1980) examined whether complex target information was treated as a gestalt or whether the individual parts of the information appeared to be processed separately. No support for or against either mode of information processing was obtained.

The above findings do not merit any clear conclusions. Before such conclusions could be drawn direct comparison within studies of complex target material is needed.

<u>Novel / Familiar</u>

Information relating to unexpected, unfamiliar, unusual and/or incongruous target material was included in the novel category. Cavanna and Servadio (1964) conducted a pilot study to investigate suitable methodologies for studying the occurrence of ESP during states induced by taking hallucinogenic drugs. Their targets were photographs consisting of very incongruous elements, for example an upside-down foot, balancing an artificial eye between the toes. The results were non-significant, although this outcome could have been due to the difficulties involved in attending to a test situation when under the influence of an hallucinogenic drug. Krippner and Zeichner (1974) obtained a higher percentage (whether or not significant was not reported) of hits when targets were described as imaginative and interesting (qualities which could be construed as novel). Ullman and Krippner (1973) ran a four subject dream study in which the same target was used for half of the testing nights and a different target used for each REM period for the other half. They observed that the the four participants preferred the use of different targets for every dream against a single target. The authors thought this indicative of the dreamers' attention being more engaged by novel ESP stimuli. In another of the dream studies (female subjects, eight nights ESP, eight of control, no significant scoring) Ullman and Krippner (1973) commented that the subjects felt that the target material should be as unusual as possible. Roll and Harary (1976) found that "interesting responses" (hits) were obtained when spontaneous, unexpected changes were made in the experiment. Two examples they provided of this involved last minute changes being made to the target material.

Several forced-choice studies have considered the effect of novelty of task and/or target material upon ESP performance. In reviewing these studies Carpenter (1977) concluded that novelty could facilitate psi-hitting for most subjects, but could be counter-productive for star subjects used to a specific routine.

Information classified as "familiar" included references to targets which held varying degrees of recognition for the percipients. Many studies have been conducted using targets of emotional significance to the subject and with which the subject would have been also necessarily familiar. However, as emotional significance was usually deemed the more important aspect of such targets, these studies will be considered under that section.

Irwin (1982) conducted a study examining the influence of subjects' familiarity with the targets. Half of the targets (Maimonides slides) were exposed to the subjects prior to testing, and half were not. This manipulation had no significant effect upon the study's outcome. Warcollier's (1938) research lead him to anecdotally conclude that only elements of a target familiar to both the subject and agent could be successfully transmitted. Targ, Puthoff and May (1979) have commented on the basis of informal observations of their own research that use of either repetitive target sequences and/or use of target pools of which the subject had prior knowledge would inhibit remote viewing success.

The few findings reported in this category do not support the drawing of any firm conclusions. There is some anecdotal support for the utility of using a different target, with which the subject is not familiar, for each testing of that subject. Also, the Krippner and Zeichner (1974) findings offer some support for the use of imaginative and interesting targets.

<u>Abstract / Concrete</u>

Abstract information included references to targets which portrayed a potentially realistic scene or object in either an abstract and/or unrealistic manner (to varying degrees) or in a not readily recognizable fashion. Krippner and Zeichner (1974) found a greater percentage of misses with targets which were described as unrealistic (whether this finding was significant was not reported). Ullman and Krippner (1973) in the series of dream studies with 'Erwin', reported that purely abstract pictures which lacked human figures gave poorer results than targets which contained human figures engaged in activity.

Information included in the concrete category would be references to target material which presented an object or scene in an immediately recognizable, undistorted manner. While a great number of studies have used targets which could be characterized as being concrete, we found no specific reference regarding the utility of this characteristic in the free-response studies.

Although Krippner and Zeichner's (1974) finding and Ullman and

Krippner's (1973) observation suggest that abstract targets may not be conducive to psi-hitting, more research is needed before firm conclusions can be drawn.

Dynamic / Static

The dynamic categorization was used to refer to informations about targets which portrayed and/or conveyed movement, a sense of movement, and/or gustatory, olfactory, auditory, tactile, and/or kinesthetic stimulation. Thus a wide diversity of target materials fell into this category including pictorial material (showing movement), film clips (containing movement), and a variety of non-visual target material such as music excerpts, the taste of a food, etc. In considering this large category perhaps it should first be noted that Braud, Davis, and Opella (1985) in their non-psi, no target study, found a predominance of activity contained in ganzfeld and dreaming imagery. Gurney, Myers and Podmore (1886) reporting on the findings of the Society for Psychical Research's Census of Hallucinations found that in cases of apparent GESP of literal reproductions of the agent's bodily sensation (pain, smell, touch, etc.) were rarely transmitted. They noted from their own experience that while taste was perceived in experimental situations, they received no accounts of such in the spontaneous reports. The spontaneous cases seldom contained reports of touch, and when it was reported it was normally associated with auditory and/or visual impressions. Music and other auditory stimuli were frequently reported. Warcollier (1963) informally observed that moving objects or the ability of the target to suggest movement seemed to be perceived by the subject. Warcollier (1938) also expressed the belief that kinesthetic sensations should be easily transmitted, but admitted to having little data to back this up. Reporting on an Esalen Meeting on Psi Research, Schlitz (1984) reported general agreement among the participants that kinesthetic, auditory and olfactory images were as important, if not more so, as visual images in conveying psi information.

Honorton and Schechter (1987), reporting on the significant ($p = 0.027$, 1-t) outcome of 187 automated testing ganzfeld sessions, found that sessions using dynamic targets (video segments and other "lifelike" material) were independently significant ($p = 0.007$, 1-t), while those using static targets (defined as "still pictures") were at chance. The difference between the two was suggestive, but not significant ($p = 0.079$, 2-t). Likewise, Krippner and Zeichner (1974) found more hits associated with targets having dynamic content (whether this finding was significant was not reported).

Altom and Braud (1976) ran a pilot study aimed at exploring the idea that right-hemisphere brain activity may be conducive to psi. They used four different excerpts of music as targets, which it was thought might encourage right-hemisphere activity. They obtained a significant level of psi scoring ($p = 0.05$). Kesner and Morris (1978) conducted a guided imagery, precognition study using music from records and their album covers as targets. The subjects' imagery was rated by an independent judge who individually rated subjects' visual and auditory imagery. Neither the results from the visual or the auditory ratings were independently significant, however the two combined were ($p < 0.02$), suggesting that the more senses involved in a target, the better.

Several dream studies have been conducted using dynamic target material. Krippner, Honorton, and Ullman (1972) obtained significant results ($p < .001$) usings thematically related slides, accompanied by an appropriate sound track. Using the same type of target material Krippner, Honorton, et. al. (1972) again elicited a significant level of psi-hitting (p = .004). An even higher level of significant scoring (p = .0002) was obtained by Krippner, Ullman, et. al. (1972) using the multi-sensory target environment described in the introduction of this paper. As previously mentioned, Ullman and Krippner (1973) found that paintings of humans engaged in activity seemed to be more successful than abstract paintings in the Erwin series. The second Erwin study, which again obtained a significant degree of psi-hitting (reported effects "on the order of a thousand to one" p.116), used art prints together with associated objects and activities on the part of the agent.

Dunne and Bisaha (1979), reviewing seven remote viewing series, noted that dynamic targets were perceived as readily as stationary ones. Yet, Puthoff and Targ (1979) commenting upon their remote viewing work said that motion was very rarely reported, even when it was an important component of the scene. Although, Targ, Puthoff, and May (1979) stated "that real-time activities at the target site are often perceived" (p.94). These authors also noted that "in addition to visually observable detail, subjects sometimes report sounds, smells, electromagnetic fields, and so forth, which can be verified as existing at target locations" (p.95). It should be noted that the above three observations were all ancedotal.

Two studies made specific comparisons between static and dynamic target characteristics. Honorton and Schechter (1987) obtained highly significant psi effects with dynamic targets, while static targets obtained chance results. Krippner and Zeichner (1974) found more hits associated with dynamic targets. The findings of Kesner and Morris (1978) and those of the reviewed dream studies further suggest the possible benefits of using multi-sensory target materials.

<u>Form / Meaning and Idea</u>

Comments related to the importance of the shape or form of the target or some of its components are included in this category. Puthoff and Targ (1979), in discussing their remote viewing work stated "most of the correct information that subjects relate is of a nonanalytic nature pertaining to shape, form, colour, and material rather than to function or name" (p. 65). Barrington (1983), reviewing past work with the medium Stefan Ossowiecki, found many examples where the form of the target had been correctly identified but not the meaning, a situation which she labelled as "incomprehending clairvoyance". Similarly, Warcollier (1938 & 1963) observed that frequently the shape of a target would be perceived without reference to the target's meaning or idea, although he also notes that meaning and idea may also be perceived without specific reference to shape. Warcollier (1938) also discusses the work of Richonnet (no reference provided) noting that Richonnet thought that form was both easier to perceive than meaning and would be perceived prior to perception of the identity (idea) of the ESP target.

The "meaning and idea" categorization includes information referring to situations where the meaning, idea and or identity were perceived, without reference to the shape or physical appearance of the target. Carington (1940) believed that the idea of a target, not the form, was what would come through to the subject. Gurney, Myers and Podmore (1886) received reports which indicated that meaning and idea were the important aspects of the target. The example they provide of this is where a word in one language is received in another, having been suitably translated. Marsh (1960), in a study using simple line drawings as targets, commented that subjects tended to reproduce the concept of the target rather than the shape. Lodge apparently shared these beliefs as, according to Warcollier (1938) he believed that an idea is more easily transmitted than a drawing (i.e. form). As noted above, Puthoff and Targ (1979) believed that most correct information provided by subjects pertained to the nonanalytic aspects of targets such as form, shape and colour. Indeed, they thought that errors could arise when the subject tried to make sense (i.e. label according to name and function) of such nonanalytical target components.

This category presents some conflicting observations and opinions, all of which are anecdotal in nature, regarding the utility of form, as opposed to meaning and idea, in conveying psi-related information. Given this state of affairs, the only conclusion that can be drawn is that research aimed at resolving this question is needed.

Emotion

Any comments having to do with the emotional content of or emotional reactions to target materials were included in this category. Some researchers have also made comments about specific target themes/content which could be interpreted as having a strong emotional component (e.g. war scenes, erotic scenes, religious themes, etc.). However, whether these themes would be regarded as positive or negative would probably vary greatly from subject to subject. Therefore, these findings will not be referred to in this section unless the author specifies that the emotionality of the target was an important factor in the study's success or failure.

Gurney, Myers, and Podmore (1886) observed that in spontaneous cases emotions were frequently received, often with the receiver having no idea why they were experiencing certain feelings. However, the emotion experienced by the percipient was later found to be appropriate to the event which was taking place at the time, unknown to the percipient (e.g. feeling sadness over the death of a close friend). Warcollier (1938) also comments that in spontaneous cases, the message is almost always emotional.

Williams and Duke (1979) conducted a study specifically examining various target qualities and their relationship to psi performance. They devised a 39-item Target Evaluation Rating which measured various target qualities, including overall emotional impact and positive and negative emotional dimensions, upon which each of 152 targets were rated. They then looked at data, gathered from 174 subjects, from other free-response studies which had used these targets. For the purposes of their analysis, they excluded any target which had not been randomly chosen as a target at least three times in the previous studies. This criterion provided 22 targets, and ESP data from 91 subjects (overall significant psi-hitting was obtained, $p < .047$, 2-t). The individual psi scores obtained for each of these 22 targets were averaged to provide a composite psi score for each target. The composite psi scores were divided into good psi targets and poor psi targets resulting in 12 high psi-scoring targets and 10 low-psi scoring targets. Comparing these targets to the total emotion score (the mean of the positive and negative emotion ratings) from the Target Evaluation Rating, they found that targets containing a stronger emotional content were significantly better (i.e. high psi-scoring targets) than non-emotional targets ($p < .001$).

Sondow, Braud and Barker (1981) conducted a ganzfeld study also aimed at investigating target qualities, which obtained a significant outcome using a sum of ranks ($p < .04$ 1-t), but did not reach significance using direct hits as a measurement. Using the Target Evaluation Rating, described above, pictorial target packs were constructed, five having a relatively high emotion rating and five having a low emotion rating. Each high emotion pack consisted of two positive and two negative emotion pictures; the low emotion packs consisted of two natural scenes and two pictures of material objects. This complex study involved many different measurements and analyses, of which only those most relevant to this paper will be reported. The neutral (low) emotion target packs showed more psi-hitting than the high emotion pictures, with the difference approaching significance (p = .052, 2-t). Using a scale they devised to measure emotion which both the subjects and agents completed, they found that when a high emotion picture was the target, receivers would feel more total emotion whilst in the ganzfeld than did receivers with a low emotion target pack (p < .04, 2-t). Also receivers felt more emotion when senders felt more emotion while sending (p < .04, 1-t). However, Stanford (1984) has pointed out that this latter finding could be artifactual due to commonalities of experience between subjects and agents (e.g. the weather that day). Using Osgood's Semantic Differential to measure the components of the target pictures, they found there more hits when the receivers' and senders' evaluation of the targets were in close agreement than when their categorizations widely differed. Of twenty targets where agreement was close, nine were direct hits (p = .04, 1-t).

Both Williams and Duke (1979) and Sondow, Braud and Barker (1981) found significant outcomes in various analyses examining how well their subjects liked (emotionally preferred) the target. Williams and Duke (1979), comparing subjects' ratings of target preference for hit and missed targets for two different groups of subjects (with the rating being made prior to obtaining feedback as to the target identity), found the first group of 101 subjects significantly preferred targets with which they had obtained a hit (p < .035, 2-t), as did the second group of 80 subjects (p < .0038, 2-t). A similar finding was reported in the Sondow et al. (1981) study, where a comparison between liking for psi-hit and for psi-missed targets again yielded a significant outcome (p < .0096, 2-t). Another analysis in this study showed that pictures received a significantly higher liking rank (p < .0094, 2-t) when they were the target than when they were a control. Braud and Loewenstern (1982) also found that psi-hitters liked their targets significantly better than psi-missers (p < .025, 1-t). Two other significant target preference findings were presented in Braud and Boston (1986). The authors replicated the preference effect (p < .036, 1-t), and also reported similar results from Braud, Ackles & Kyles (p < .045, 1-t). However, these findings may be contaminated due to response bias problems. To quote Stanford (1984) "these findings could be artifactual;... Because of their desire for success, subjects may tend to like pictures which correspond to their ganzfeld mentation, and such correspondence tends to be greater and more detailed when ESP has actually occurred. Thus such pictures may be liked appreciably more." (p. 107). Many forced-choice studies have examined the role of target preference. These findings have been reviewed by Carpenter (1977) and Palmer (1978). In drawing some conclusions about these findings Palmer comments that while a preferential effect has been found most often "with respect to response type rather than target type, it (the preference hypothesis) offers our best hope to date of intergrating a very messy and inconsistent body of data concerning the effect of target type on ESP scoring in forced-choice experiments." (p. 87).

Krippner, Honorton, et al. (1972) considered their targets (thematically related slides and appropriate sound tracks) to be emotionally arousing, and thought that their significant results provided support for the use of such material. Ullman and Krippner (1973) also felt "that an important ingredient in the success of experiments in dream telepathy over waking telepathy ... is the use of potent, vivid, emotionally impressive human interest pictures to which both agent and subject can relate." (p. 210).

Moss (1968; also see: Moss, 1969; and Moss & Gengerelli, 1968) described the evolution of her experimental methodology over a series of six experiments. Emphasizing the importance of using emotionally arousing targets, her targets evolved to consist of slides accompanied by appropriate sound effects paired so as to present contrasting emotions. The results from these studies were very sketchily presented, although significant outcomes were described for some of the studies. However, no comparison was made between either emotionally arousing targets and neutral ones, or between the effectiveness of the different contrasting emotions. In a series of studies Preiser (1986) found that ESP performance was highly dependent on the emotional loading of the target material. The information about this study is limited as it was obtained from an abstract. However, while no overall significance was obtained, one part of the series did get a significant ESP outcome. Cavanna and Servadio (1964) stressed the careful choosing of targets which they considered to have definite emotional significance. While they did not obtain significant psi-scoring, they did express the belief that their future targets should be chosen to be even stronger, emotionally.

Some studies utilizing physiological measurements have used targets chosen to have specific emotional significance for individual subjects. Esser, Etter, and Chamberlain (1967) used plethysmographic responses to personalized target material, devised from initial interviews with the participants. The resulting targets, designed to have greater emotional significance for either the percipient or the agent, were either names of importance to the subject or sentences or quotes describing a emotional conflict of relevance to the participants. No significant outcomes were obtained, but the results were suggestive in that there was some correspondence between onset of the sending period and plesthysmograph responses. Dean (1971) contrasted plethysmograph recordings of vasoconstriction examining the reaction of subjects to targets consisting of either a blank card or a card upon which was written a name of a person who has emotional significance to the subject. He found larger vasoconstrictions (i.e. more emotional arousal) for the names than for the blanks. This study also had a group of control subjects for whom the names would have had no special relevance. Interestingly, he found that the control subjects displayed a greater level of reaction to the names than did the subjects for whom the names had emotional significance. Haraldsson (1983) again used names of emotional significance to the participants as the target in a study using a plesthysmograph. No overall significant results were obtained, however, he did obtain a significant outcome in the first 20 sessions of the study ($p < .003$), with results declining later.

Several studies have compared targets having positive emotional qualities to those having negative emotional characteristics. Williams and Duke (1979), comparing good psi targets to poor psi targets, found that targets which contained a positive emotion were significantly better targets ($p < .02$) than those which did not and that targets which contained negative emotion were significantly worse ($p < .047$) than those which did not. Sondow, Braud and Barker (1981) found no significant difference between positive and negative emotional targets. Eisenberg and Donderi (1979) used 7 emotionally stimulating sound films as targets in a study incoporating both forced-choice and free-response conditions. They obtained a significant degree of psi-hitting (forced-choice condition: $p < .02$; free-response condition: $p < .001$). The film clips were classified as conveying either positive or negative emotions, although no significant difference was found between the scoring on the positive and negative emotional targets. Krippner and Zeichner (1974) found more misses when the target was described as pleasant and more hits when the target was described as unpleasant (whether these findings were significant is not reported).

One forced-choice study which specifically addresses the positive/negative issue was conducted by Johnson (1971) who asked subjects to provide two words, one having an exceedingly pleasant meaning for the subject and the other having a very unpleasant meaning, from which he created targets of associated words/concepts. These concepts (secondary targets) were paired with a digit from one to five (primary targets), although 20 per cent of the primary targets were left unpaired as a control (emotionally neutral targets). The subjects in this precognitive study were to guess what number would be selected as the target. Johnson compared performance on positive, neutral and negative emotions. No significant overall scoring was obtained, the positive targets showed a non-significant degree of psi-hitting, the negative targets significantly psi-missed ($p = .0094$, 1-t), and the neutral targets scored at chance. The difference between the positive and negative targets was significant ($p < .005$, 1-t).

The anecdotal observations in this category reveal that many researchers believe emotional targets to be superior to non-emotional ones. However, only two studies (Williams & Duke, 1979; and Sondow et al., 1981) explicitly examined this assumption and they obtained conflicting results. One analysis in Sondow et al. (1981) found that the percipient would experience more emotion with a high emotion target, but as this study also obtained a greater degree of psi-hitting with low emotion targets, this result could be seen as arguing against the use of high emotion targets. Nor can the physiological studies be readily interpreted as providing support for the utility of using target material chosen to have specific emotional significance for individual subjects. Aside from the general lack of significant outcomes of these studies, the Dean (1971) study actually obtained a greater response from his control subjects to whom the target material should have had no special relevance. The studies comparing positive emotional targets to those with negative emotive qualities also obtained conflicting results. Thus, again more research is needed before any conclusions can be drawn regarding the psi-conducive effects of emotional targets.

<u>Theme / Content</u>

This category includes all references which associate the specific content or theme of individual targets with the success/failure of these targets. Williams and Duke (1979) found that "most of the psi-hitting targets were natural, while the missing targets were material objects—metal, concrete, man-made, and mechanical."(p. 8) A post hoc analysis revealed this difference to be significant ($p < .02$). Dunne, Jahn, and Nelson (1983), reporting on several remote viewing studies, noted that there was no difference in effectiveness between the following site characteristics: natural vs. man-made; permanent vs. transient; and indoor vs. outdoor. The Psychophysical Research Laboratory (1985) compared various target contents to see if some were more successful than others. The category of "disasters" obtained significant psi-hitting ($p = .014$, 2-t). Sexual themes were associated with significant psi-missing ($p = .008$, 2-t). Non-significant scoring in the psi-hitting direction was obtained by (listed in descending order of strength of effect) the categories of religion, sports/hunting, locales, and animals. Non-significant scoring in the psi-missing direction was obtained by the racing and fighting/warfare categories. A post hoc analysis by Sondow (1979) found that targets were chosen and non-targets avoided significantly often when the pictures showed horses ($p < .01$), water ($p < .02$), fire ($p < .03$), and flying-leaping-swinging ($p < .04$). Such effects were not found with the target categories of food, war and famine, and music. Ullman and Krippner (1973) observed that the art prints containing/portraying religion, colour, eating/drinking, emotions, and people tended to be successful, as did the agent's multi-sensory involvement with the target. Stuart (1945), using simple line drawings as targets found that the two most successful targets portrayed a cartoon character and a candle. The two least successful targets were a book and a mathematical equation. In another drawing study, Stuart (1947) found the best target was a church and the worst was a train. Lastly, Braud, Davis, and Opella (1985) found a predominance of human characters and architectural content contained in ganzfeld and dreaming imagery. Less frequent were mythical characters, animals, food, and unconnected body parts. These findings could contribute to spurious anecdotal observations.

Examining these diverse content categories it was discovered that religion was mentioned three times as a generally successful target topic. Warfare was twice mentioned as being less successful. Williams and Duke (1979) found that natural targets were associated with psi-hitting, and the categories specified as successful by Sondow (1979) could also be classified as natural. However, given the wide diversity of actual targets which these findings represent, these similarities should be viewed at most as possible trends which require further reseach for confirmation.

Discussion

The most consistent category findings of this paper relate to the possible advantages of using dynamic, multi-sensory targets. However, these findings are based on the outcome of relatively few studies and thus should be treated with caution pending further confirmation. The novel category provided some tentative support for the use of new targets with which the subject is not familiar for each trial with that subject, and also suggested possible benefits of using imaginative and interesting targets. But again these finding are derived from very few studies. The two findings relevant to the abstract categorization both found abstract targets to be associated with poorer results. The emotionality of targets, often quoted in the literature as one of the yardsticks by which targets are chosen, has not been shown to be reliably associated with psi-hitting. Nor have any of the other categories investigated herein.

In short, this review has not succeeded in shedding a great deal light upon what qualities/characteristics might discriminate successful from unsuccessful free-response targets. Indeed, the outcome of this paper could be viewed as demonstrating how very little we actually know about successful versus unsuccessful target characteristics.

However, another interpretation of these findings could be that target characteristics can not be consistently related to successful outcomes due to individual subject differences. Many years ago Warcollier (1963) commented that "No two subjects respond alike to the same target. No two targets seem to affect the same subject in the same way."(p. 56). Indeed, a great deal of experimentation has examined and revealed interactions between various trait factors and psi performance (for reviews of this literature see Palmer, 1978; or Carpenter, 1977). Other variables such as state, setting, response method, and so on, may also influence the particular type of target which is successful in any given situation. Future research could profitably examine the effects of such variables. In addition, the development of a descriptive set of scales, such as the three-dimensional scale discussed in the introduction of this paper, which could be used on an inter-laboratory basis, could forward our knowledge of target success considerably. The development of such scales will be the focus of future research at the Edinburgh Lab.

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CHARACTERISTICS OF SUCCESSFUL FREE-RESPONSE TARGETS: THEORETICAL CONSIDERATIONS

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ABSTRACT

This paper describes theoretical ideas from a variety of sources as to what might be expected to make a successful free-response GESP target. Popular "how to be psychic" literature, analyses of the characteristics of spontaneous cases, and theoretical suggestions from psychology and parapsychology show considerable consistency in their suggestions about the likely features of a good target. Two main recommendations appear to emerge from these sources - good GESP targets should be *psychologically salient* and *physically salient*: 1. targets in parapsychological research should be meaningful, have emotional impact and human interest - this may make them salient in the minds of our experimental participants; and, 2. targets should also be physically salient by standing out from their backgrounds - properties such as movement, novelty, brightness and contrast tend to make stimuli physically salient.

CHARACTERISTICS OF SUCCESSFUL FREE-RESPONSE TARGETS: THEORETICAL CONSIDERATIONS[1]

INTRODUCTION

Deborah Delanoy (1988) examined the observations from some free-response literature on what makes a good GESP target. Despite the flaws and contradictory findings seen in this literature, it was possible to make a few general statements about what experimenters believe constitutes a good GESP target. This paper can be seen as forming the second half of our observations and thoughts about targets in parapsychological research. Delanoy described what *is* currently believed about the characteristics of successful GESP targets, concentrating on relatively formal free-response experiments in parapsychology. In contrast this paper describes theoretical suggestions as to what *might be expected* to make good targets, roaming more widely (and consequently with less depth) over some varied literature which has something relevant to say on this question.

As stressed by Delanoy, our combined efforts are far from comprehensive, being primarily aimed at getting some idea of what kind of targets we should use in our research in Edinburgh. To do this, we looked through some parapsychological journals (JASPR, JP, JSPR, EJP, IJP), parapsychological abstracts, PA and PF convention proceedings, RIP, Parapsychology Review, certain "relevant" books held in the Koestler Chair library, and I have also examined some psychological research which I consider relevant to the target question. Particular attention was given to cases where authors made specific comments about the characteristics of successful GESP targets.

Firstly, this paper briefly considers so-called "Airport Project" books [named after some research by Professor Robert Morris and his students using the kind of "how to be psychic" books which can be found in airport bookshops (Morris, 1977)]. Secondly, the paper examines (again briefly) the kind of "target" information which seems to be transmitted in people's spontaneous psychic experiences. Thirdly, this paper considers some theoretical suggestions by parapsychologists as to what might be expected to make a good GESP target. Then I make some suggestions of my own on possible characteristics of a successful GESP target, derived from some of the psychological literature on human-environment interactions, curiosity, attention, and attributions of causality. The paper ends with a summary and conclusions.

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1. "AIRPORT PROJECT" BOOKS

A skim through the 21 "how to be psychic" books which form part of the Koestler Chair library, and which I felt might have some comments to make about targets, found only 6 authors who made recommendations on what might make a good target when training psychic powers. Even then, the authors invariably failed to define their terms or write more than a sentence on the subject. These recommendations should therefore be treated with caution, as they do not represent the findings of careful scientific experimentation. On the other hand, they may have something to suggest about popular ideas of what makes a good GESP target, and these ideas may be based on some grain of truth.

Boswell (1969) recommended the use of "mentally stimulating" targets. Also, he felt that physical sensation and especially emotion were easily transmitted, and that colour was picked up better than black and white. Edwards (no date) suggests that faces and pictures make good targets. Denning & Phillips (1981) recommend trying to transmit a message of emotional significance to the receiver. Likewise, Sherman (1960) says that it is crucial to have some emotional content to the target. A related area of interest is psychometry, where an object is used to provide further information about its owner. Powell (1979) recommends using as a token object metal or leather which has been close to the skin for a long time and therefore has had a chance to build up some personal association with the owner. Finally, Burns (1981) feels the following make good practice targets for developing GESP: pictures (rather than words); something experienced vividly by the agent; flavours; body position of the agent, or whether the agent is sitting in the light or dark; and sizes and weights of objects.

There do seem to be some common themes in these authors' suggestions, though the small sample covered here means that any patterns could be illusory: emotional impact seems to be important (though little is said about whether the specific emotions should be positive or negative ones); and targets conveying information about events happening to humans seem popular.

2. SPONTANEOUS CASES

There is a considerable literature concerning the sort of information conveyed in spontaneous cases of ESP, and so as a necessary constraint this section is limited to observations from Sybo Schouten's (1979b, 1982) examination of two great collections of spontaneous cases - *Phantasms of the Living* and the Louisa Rhine collection.

Schouten made a quantitative analysis of these collections with a view to finding patterns and relationships which might stimulate further experimental research. As he pointed out, the two collections covered quite different cultures and eras, and were gathered for different purposes. The collectors of the "Phantasms" cases took great pains to investigate and verify their cases, and had a special interest in receiving apparition reports as they felt these might lend support to their hypothesis that information transmitted in spontaneous cases came from living rather than deceased persons. In contrast, the Rhine collection took cases more or less at face value, with the idea that inaccuracies would cancel each other out over a large number of cases, and the reports were gathered with the aim of providing suggestions for future laboratory research (Schouten, 1986).

Excluding 150 of the cases (for reasons outlined in Schouten 1979b), Schouten analysed the remaining "Phantasms" cases according to 32 previously-defined categories (Schouten, 1979a) and found that about 75% of the cases involved death, illness or injury to the target person, though a tendency to remember serious events for longer than trivial events accounted for some of this pattern. Only 1.4% of cases conveyed information about positive experiences of the target person.

Table 1 (from Schouten, 1979b, p.432)

Situation of target person at time of experience

death	66.7%
serious illness	12.5%
slight injuries	8.7%
serious material	.5%
slight material	.2%
trivial	10.0%
positive	1.4%

It is interesting to note that slight personal injuries were more often the topic of spontaneous experiences (8.7%) than serious material damage (for example, a building on fire, considerable financial loss) (0.5%). This suggests that negative events related to humans are particularly strong targets in spontaneous cases.

Similar patterns are observed in Schouten's (1982) study of the Rhine collection, where he analysed a representative sample (15%) of cases (excluding PK). About 75% of the sample concerned negative events such as death, injury and accident while almost no cases concerned material damage. As with the Phantasms study, a tendency to remember and report serious events more often than non-serious events accounts for some of this pattern. However, the distribution of negative events in the Rhine collection differs from the Phantasms collection, with the former having fewer cases involving death of the target person (37.7% compared with 66.7%), but more cases involving serious accidents and slight injuries. As Schouten points out, part of this difference may be due to the Phantasms collectors' preference for apparition cases.

In summary, Schouten's analyses of spontaneous case collections suggest that **negative events related to humans** feature predominantly as "targets", although this observation may be partly due to a reporting bias. It is significant that both the Rhine and the Phantasms cases share this pattern despite the very different methods used to gather these collections. Evidently parapsychologists cannot inflict physical injury on their experimental participants in order to simulate real-life spontaneous cases. However, negative physical events are likely to have a negative emotional impact both on the target person and on the percipient (especially if they are emotionally close). Possibly, therefore, targets which have some strong negative emotional impact on a person may have more success in a free-response experimental setting than trivial or impersonal targets. Further, it might be expected that any emotional impact is better than none, and so positive emotional targets could perhaps be successfully used in experimental research - this might circumvent any researcher's concern about the ethics of exposing experimental participants to unpleasant targets.

3. THEORETICAL SUGGESTIONS BY PARAPSYCHOLOGISTS

Although this is not a comprehensive review, I have tried to cover instances where authors have made specific comments about likely successful targets. Their suggestions range from post hoc inferences based on the kinds of targets which were successful in experimental studies to observations of what makes a good target in areas of research related to parapsychology.

Le Shan (1977) criticizes parapsychologists for often neglecting to consider the theoretical assumptions underpinning their research. There has been little discussion, he feels, of what *kind* of information psi transmits even though there seems to be wide agreement that psi does transmit information. As an example of how theorising on this issue might influence our experimental design and choice of target material, Le Shan considers the possibility that psi might depend on individual differences, being better adapted for one purpose with one person and another purpose in a different person. In this case, he suggests we should "customize" our targets by examining experimental participants for their personal interests, philosophies, preferred sensory modalities, and so on.

One of the few studies specifically to examine how target characteristics relate to psi performance was conducted by Williams & Duke (1979), who go on to discuss theoretical suggestions derived from their observations. Taking an evolutionary perspective and asking what sort of information might have been most crucial to communicate before language evolved in humans, they conclude that targets reflecting "emotion, sex, survival, nature, food and other basic concerns might be psychically perceived better than other types of targets" (p.15)

In a similar vein, a theoretical paper by Nash (1980) on the characteristics of psi communication considers that, to be effective, psi communication must convey "meaningful information". Also, one of the Maimonides experimental participants, in a letter to Ullman and Krippner, gave her overall impressions of a dream telepathy series in which she had recently participated. She felt that the more "potent and unusual" the target material the better, because with subjects who might be subconsciously afraid of telepathy this kind of target might be less likely to be "kept out" (Ullman & Krippner, 1973). Perhaps unfortunately, it is very rare to find any published opinions from the experimental participants who play a crucial part in parapsychological research.

William Braud (1982) questioned the assumption which appears to underlie much of our research - that psi involves redundancy with our other known senses. For instance, most of our experimentation involves primarily visual targets such as art prints. Braud suggests that it would be useful if psi provided information which is not immediately evident to our other known senses. Such non-evident information could concern the larger relationships in which a target participates, for example its history. Similarly, Gertrude Schmeidler in her 1971 PA Presidential Address stated that the ESP target is not the physical stimulus variables, but the "meaning" of the target or an "informational pattern" (Schmeidler, 1972). Braud conducted a pilot experiment to test the theory of non-evident psi, where subjects were confronted with five identical boxes containing, respectively, three control objects and two samples of hair cut from one person's head. The hair samples were therefore related to each other, while the control objects had no long-term association to a particular person. Subjects were told which box was the "key" (one of the two boxes containing a hair sample) and, while remaining unaware of the contents of all the boxes, were asked to rank the remaining four boxes according to how "related" their contents were to the contents of the key box. This study failed to achieve significant results, but this may still be an idea worth further investigation.

The 1986 Esalen Conference discussed techniques to improve the reliable practical use of psi abilities. Targ (1987) recommended that experimenters look for common elements in the "psychic appearance" of targets (i.e. in mentations), and that they should compose a glossary of typical target transformation errors. Tart (1987), at the same conference, suggested that experimenters create a pool of "hot" targets - ones that are consistently successful, either because they are correctly described or are described in a recognisable fashion. In other words, what makes a good target would be defined operationally.

So far, this section has considered research purely within parapsychology. Some parapsychologists have taken a more interdisciplinary approach, however, and have related the findings from other areas of research back to the question of what makes a good GESP target.

Tart (1982) looked at how responses to targets are measured in conventional psychophysiology, and asked what were the characteristics of a successful target in this field of research: what kind of stimuli are most readily responded to, and easiest to analyse. To be successful, a target stimulus in psychophysiology should **stand out from its background**. For targets in parapsychological research, this may be achieved by having the target stimulus occur suddenly, be discrete in time, and have what Tart calls "psychic intensity" - the sense that the target is important and meaningful within the experimental context. Tart suggests that we could instruct our experimental participants on the significance of the target in order to give it the required meaningfulness. Psychic intensity could also reflect an intense event happening to an agent - a methodology which Tart finds attractive. The idea that a good target should stand out from its surroundings is strongly supported by the psychological literature on human attention which I will be introducing later.

A second area of research which has had some heuristic value for parapsychological research concerns subliminal perception, or preconscious processing (Dixon, 1981). Comparisons of psi and subliminal perception have noted that "right hemisphere" processing facilitates subliminal perception (Roney-Dougal, 1981, 1986) - a suggestion which has also been made for psi perception (e.g. Braud, 1975). This could suggest that "right hemisphere targets" such as music, pictures and other non-analytic targets might be preferable to "left-hemisphere" targets such as words and numbers. Another parallel between psi and subliminal perception is that emotive stimuli can evoke clear autonomic responses in the percipient in both cases (Roney-Dougal, 1986).

Serena Roney-Dougal feels that the use of negative emotional targets is both morally and methodologically unsound, partly because some of her subjects reported unpleasant experiences while receiving target impressions and might psi-miss with this kind of target, and also because of the perceptual defence phenomenon seen in subliminal perception. Sondow, Braud & Barker (1981) considered that "defensive" subjects might be likely to psi-miss with unpleasant targets, and devised an "Openness Questionnaire" to identify such subjects. They found no significant difference between the "openness" of receivers who psi-hit and those who psi-missed in a ganzfeld study. Unfortunately, no extensive description is made of the format of the questionnaire, or of whether or not it measures perceptual defensiveness as seen in subliminal perception or some other, unspecified, form of defensiveness.

In perceptual defence, a person may raise his or her recognition threshold for a threatening or unpleasant stimulus - in other words, they perceive it less clearly. Roney-Dougal interprets this as being due to the person's desire or motivation not to perceive the threatening stimulus, a motivation which, she feels, may underlie psi-missing also. However, Dixon reports experiments which suggest that the perceptual defence effect, rather than representing the motivations of the experimental participant, is best explained in physiological terms: emotive stimuli cause changes in a person's arousal level which in turn affect the sensitivity of the sensory receptors.

Whatever the mechanism of the effect of emotional stimuli on recognition thresholds, it is clear that this effect is not uni-directional. One aspect of perceptual defence which, it seems, tends to be overlooked is sometimes called vigilance. While some people may raise their recognition thresholds to emotional stimuli, others may actually *lower* them (Brown, 1961; Dixon, 1981). Without digressing too much on the reasons for this apparent contradiction, it has been found that there is a correlation between personality-type and a person's tendency to raise or lower his or her recognition threshold, with extroverts raising their thresholds, and introverts lowering them (Brown, 1961; Corcoran, 1965). This has some interesting implications for parapsychology. While Roney-Dougal felt that the raised recognition thresholds seen in perceptual defence might be linked with the psi-missing of her own subjects with negative emotional targets, other researchers have found the opposite (Delanoy, 1988), and the vigilance effect suggests that some parapsychological subjects could even psi-hit with unpleasant targets. Donn Byrne (1961, 1963, 1964) has developed a "repression-sensitization" scale which indicates whether a person might be expected to be defensive or vigilant - perhaps parapsychologists could study the mechanisms of psi-hitting and psi-missing with the help of this scale (Crandall, personal communication, 1988).

Having looked at popular literature, spontaneous cases, and theoretical suggestions from parapsychologists on what might make a good target, I will now make some inferences from areas of psychology which I consider to be relevant to this discussion.

(1) EMOTIONAL RESPONSES TO STIMULI

Mehrabian and Russell (1974) outline a theoretical approach to environmental psychology (the study of the impact of the physical and social environment on man's emotions, attitudes and behaviour). In their own words, "Evidence suggests that there are three basic emotional responses (pleasure, arousal, and dominance) *(the dominance-submissiveness dimension refers to the degree of control which individuals feel they have over a situation or environment)*, combinations of which can be used to describe adequately any emotional state (e.g. anxiety). By considering their impacts on these basic emotional dimensions, the effects of diverse stimulus components within or across sense modalities (e.g. color, pitch, texture, temperature) can be readily compared" (preface, Mehrabian & Russell, 1974, [*my italics*]).

There is evidence of considerable intermodality of human response to stimulation - that is, stimulation in one sensory modality may affect perception in another. For instance, people who visualize auditory stimulation tend to agree in associating colour names and mood adjectives with types of music: "Such persons were found to visualize exciting music in bright forms or sharp and angular figures, and slow music in rounder forms" (p. 11, Mehrabian & Russell, 1974). The three basic emotional responses to stimuli reported above (pleasure, arousal and dominance) are seen as providing a measure with which to compare people's varied intermodal responses to stimuli. This is relevant because it suggests that an additional important aspect to our consideration of what might be expected to be salient features of a GESP target is not only the actual physical characteristics of the target, but also the emotional response (a combination of pleasure, arousal and dominance) which that target elicits in the percipient.

Further, the theory may provide a methodological framework for the consideration of the impact of various target characteristics on our experimental participants (Delanoy, personal communication, 1988). A semantic differential scale is used to measure people's emotional state in particular settings, or to measure their characteristic emotions over time. Mehrabian and Russell's scale comprises 18 adjective pairs describing various aspects of pleasure, arousal and dominance, and their subjects are asked to mark on the scale the degree to which one or other of the adjective pair most accurately reflects their feelings. Semantic differential scales have already been used in parapsychology, though for different purposes than suggested here. McBain et al (1970) used Osgood's Semantic Differential to find pairs of people with common affective reactions to the same concept, though, contrary to their expectations, they found no relation between the degree to which people agreed in their reactions to the target stimulus and their GESP scores with that stimulus. Sondow, Braud & Barker

(1981) used Osgood's Semantic Differential as one of several measures of target picture emotionality. However, it should be possible to make more extensive use of the semantic differential, and it is planned to investigate further how a scale such as Mehrabian & Russell's could be adapted to measure the reactions of parapsychological subjects to targets and to provide a method to standardise descriptions of successful targets.

The second aspect of Mehrabian and Russell's theory of environmental psychology which may be relevant to our discussion about targets is their consideration of how emotional reactions to physical environmental stimuli are related to the concept of approach-avoidance. This they define broadly as including "... physical movement toward, or away from, an environment or stimulus, degree of attention, exploration...favourable attitudes such as...preference or liking..." (p.96, Mehrabian & Russell, 1974). Arousal is seen as a mediator of approach-avoidance behaviour. A literature review suggests that approach-avoidance is an inverted-U-shaped function of arousal: an organism seeks an optimum level of arousal - whether or not it approaches or avoids a stimulus depends on how arousing the stimulus is, and extremely high or low levels of arousal are avoided.

In animals, there is a tendency to explore the unfamiliar. When the stimuli are fear-inducing, animals repeatedly withdraw and approach the stimuli. Mehrabian and Russell note that the animals are maintaining an optimum level of arousal with this behaviour. Similar behaviour is seen in human children and adults (for references see Mehrabian & Russell, 1974; Berlyne, 1960). Anecdotally, humans do seem to have a penchant for voluntarily and repeatedly exposing themselves to negative emotive and fear-inducing stimuli - hair-raising roller coaster rides and horror films, for example.

The idea of approach-avoidance being mediated by arousal relates to the consideration above (re perceptual defence and vigilance) of the merits of using negative emotive targets in parapsychology. It suggests that people might have some attraction to negative emotive targets insofar as these targets tend to *increase arousal.* Too much arousal, however, will cause people to withdraw from an unpleasant target. On the other hand the use of neutral and bland GESP targets is unlikely to arouse our experimental participants at all, consequently failing to elicit approach. Of course, positive emotive targets would also be expected to influence the arousal of our subjects and to elicit approach-avoidance behaviour.

A second area of psychological research which may make suggestions relevant to the question of what makes a good GESP target concerns the characteristics of stimuli which attract people's attention.

(2) STUDIES OF ATTENTION

While the theory discussed in the preceding section suggested that stimuli could be described in terms of people's basic emotional responses to them, other research has examined characteristics of the stimuli themselves, to see what stimulus features tend to attract attention. Insofar as it may be possible to generalise from research on psychological processes to currently unknown psi processes, this research may be relevant to the discussion here as it could suggest the kind of target features which might attract the attention of our experimental percipients in free-response GESP tasks.

Berlyne (1970) noted the difficulty of even defining what is meant by the word "attention". In his series of experiments (described in Berlyne, 1960) on curiosity, conflict and arousal he seems to use an operational definition. These experiments typically presented the subject simultaneously with several stimuli and observed the percipient's eye fixation movements - the inference being that attention was given to the stimulus which attracted most eye fixation (e.g. Berlyne, 1958). Other experiments used a different measure of attention, allowing subjects to expose themselves to very brief sights of stimulus pictures as many times as they liked - presumably attention was attracted by the stimuli which were chosen to be seen most often by subjects. The characteristics of stimuli which seemed to influence direction of attention included: intensity; brightness; contrast; colour; novelty; complexity; and incongruity.

Intensity. Berlyne (1960) states that the intensity of stimulation is seen in "the frequency of nerve impulses and the number of fibers activated" (p.170) in the reticular arousal system. Generally, large stimuli are more intense than small stimuli; "warm" colours (e.g. red) are more intense and arousing than "cold" colours (e.g. blue); high-frequency sounds are more intense than low frequency sounds; and (in cats and monkeys) painful stimuli are most intense, followed by proprioceptive, auditory, and visual stimuli respectively. Berlyne found that attention was attracted by relatively intense stimuli - for example, to larger than to smaller circles; to brighter than to dimmer visual stimuli. Intensity is related to brightness, which also appears to attract attention.

Colour. Infants preferred looking at colour to looking at black and white stimuli. Adults' attention was attracted more to a coloured stimulus than to a white one (Berlyne, 1960).

Contrast. It was found that attention was attracted to a lighter stimulus on black and medium grey backgrounds, and to a darker stimulus on a white background. So, contrast with the background attracted attention. Above we saw that brightness also attracts attention. When presenting subjects with stimuli which differed from their background to equal extents but in different directions, it was found that subjects were more likely to respond to the lighter stimulus - that is, in the absence of a contrast difference, brightness was a secondary determinant of attention (McDonnell, 1968).

Novelty. This can be defined as an unusual combination of parts of various objects, or a change from the kind of stimulus to which the organism has recently been exposed (Stotland & Canon, 1972). It has repeatedly been found that novel stimuli attract more attention than familiar stimuli (e.g. Langer, Fiske, Taylor & Chanowitz, 1976; Berlyne, 1958), though the effect of novelty declines over time (perhaps as the subject habituates to the stimulus and arousal drops). Berlyne (1960) considers attention to be most effectively attracted by a stimulus whose novelty is often renewed. Novelty is related to change or surprisingness of a stimulus (Stotland & Canon, 1972). On surprise, Berlyne says "In experiments on learning, orienting behaviour *(a set of psychological and physiological responses through which the organism "sits up and takes notice" when an aspect of its environment changes)* is often found to be strengthened by an unheralded change in experimental conditions" (p. 98, Berlyne, 1960, *[my italics]*). This observation strongly resembles one made from a parapsychological experiment by Roll & Harary (1972), that "some of the more interesting results came when unannounced changes in the experiment were made spontaneously", and similar results occurred "when there was a last-minute change in the target materials" (p.4).

Complexity. This can be defined as the number of distinguishable parts which a stimulus possesses, the degree of difference among these parts, and the difficulty of integrating the parts involved (Stotland & Canon, 1972). Incongruity, evidently related to both complexity and novelty, was found by Berlyne (1958) to attract attention. Under examination, the distinction between complexity and novelty grows blurred, and, as Stotland & Canon point out, both involve stimulus change. Humans seem compelled to attend to stimulus change - a response which might be expected to be evolutionarily adaptive. Infants are attracted to relatively complex visual patterns and the attention of adults is also determined partly by stimulus complexity (Berlyne, 1960; Jeffrey, 1968).

This research on the determinants of selective attention also states that, consistent with the discussion earlier of approach-avoidance behaviour, people seek an optimum level of arousal: either too much or too little arousal is unpleasant for individuals, and factors such as stimulus novelty, complexity, intensity and incongruity are seen as contributing to an organism's arousal.

The research outlined above tended to use fairly sterile tachistoscopic stimulus presentation, however more recent studies of human causal judgement in social situations have shown that these early findings can generalise to much more realistic and complex situations. Shelley Taylor and Susan Fiske (1978), reviewing the literature on the influence of salient stimuli on people's causal judgements, found that **bright, contrasting, moving and novel** stimuli all attract attention in social situations (e.g. Langer et. al., 1976; McArthur & Post, 1977). Movement can be regarded as simply another aspect of stimulus complexity/novelty, and we have already seen that stimulus change (a feature of movement) compels attention.

As it is not yet clear whether the process of psi perception is similar to perception with our known senses it may be argued that the above findings from psychology on attention-grabbing stimulus characteristics may not generalise to the "psi stimulus". However, it would seem to be evolutionarily adaptive for any organism to attend to bright, contrasting, moving and novel stimuli as such features may indicate either food or threat to the organism. Insofar as psi perception may be an evolved attribute or ability, we can expect it to have become especially [illegible] survival-related stimulus features such as those outlined above.

For parapsychologists, these findings suggest that: 1. stimuli which are likely to attract the attention of our experimental participants and consequently make successful GESP targets may possess the following characteristics in some (as yet unspecified) degree or form: movement, complexity, novelty, incongruity, contrast, colour, brightness and intensity; and, 2. these attention-determining target characteristics must be present at **moderate levels** - too much and our subjects will be overwhelmed, too little and they will be bored.

SOME LIMITATIONS OF THIS PAPER

Although this paper may seem to have rambled over a wide range of subjects, it has mainly been restricted to a consideration of targets' physical features, and has not examined in any depth the idea that "the target" is in part defined by the experimental participant's own personal reactions to and interactions with it. Taylor & Fiske (1978) considered some ways in which the salience of a stimulus may be influenced by factors independent of the actual physical stimulus characteristics, and the following table summarizes their findings.

Table 2 (after Taylor & Fiske, 1978)

Determinants of Selective Attention

Properties of Stimuli
- Brightness
- Contrast
- Movement
- Novelty

Properties of Situation
- Environmental Cues
- Instructional Set

Properties of Perceiver
- Temporary Need States
- Enduring Individual Differences in Traits, Reinforcement Schedules, Schemas

---

As Table 2 suggests, properties of a situation and properties of the perceiver may influence what aspects of an individual's environment, or a free-response target, appear as salient to any individual. For instance, if a person is hungry then food will become especially salient to that individual. An individual's cognitive schemata will play some part in determining the direction of his or her attention (Stotland & Canon,

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Reference: MDA908-93-C-0004
Data Item No. A001 SG1J
Project Periodic Status Report

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As you know, we are required by the official contract to deliver formal reports. So, here is our Periodic Status Report deliverable dated 10 September 1993. We are required by contract to distribute the deliverables according to the Contract Data Requirements List. Although it specifies the reports should be mailed to RSQ-4, I am sending them to you for the final distribution:

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Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Edwin C. May

Edwin C. May, Ph.D.
Director, Cognitive Sciences Laboratory

cc Tom Albert/w/enclosure
Joe Angelo/w/enclosure
Betty Muzio/w/o/enclosure
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April 23, 1993

Defense Intelligence Agency
Bolling AFB, DT-5
Washington, D.C. 20340-6150

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If you have any questions, please do not hesitate to contact me at (415) 325-8292.

Sincerely,

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cc Tom Albert/w/enclosure
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1972). If a person has a phobia of spiders, then a picture of a spider will be very salient to that person, while it may have no impact on another person who has a phobia about water. If we as researchers instruct our experimental participants to attend to one aspect of their environment, then that feature will become salient to them. So, we see that there are many influences on what makes target characteristics grab attention, and it is unwise to restrict our view to physical target characteristics alone. Nevertheless, these conclusions about the salience of physical target characteristics remain valid so long as it is appreciated that they do not give the whole picture.

SUMMARY AND CONCLUSIONS

The present paper considered theoretical ideas of what might be expected to make a successful free-response GESP target.

1. Popular literature on the training of psychic powers suggested that emotional impact and human interest content made good targets. A survey of patterns seen in spontaneous cases seemed to support these observations: the bulk of the information transmitted concerned negative events related to humans, though reporting bias accounted for some of this pattern. While parapsychologists could not physically harm their subjects, it was suggested that the emotional impact seen in spontaneous cases could be incorporated into target material for experimental research, as observations from spontaneous cases suggested that such targets might be expected to have more success in an experimental setting than trivial or impersonal targets.

2. Varied theoretical suggestions by parapsychologists on what might make a good target suggested that meaningful, emotional and potent targets could be expected to be successful in GESP research. Studies of characteristics of good targets in conventional psychophysiology suggested that targets in parapsychology should stand out from their background. This might be achieved by having the target event occur suddenly, be discrete in time and be "important" to the percipient.

Several parallels were noted between subliminal and psi perception. From perceptual defence and vigilance effects seen in subliminal perception it was suggested that, paradoxically, while some parapsychological subjects might be expected to psi-miss with negative emotional targets, others might psi-hit with such targets. It was suggested that the Repression-Sensitization Scale, diagnostic of an individual's tendency to be defensive or vigilant, might be useful to parapsychologists wishing to pursue these ideas.

3. Two areas of psychological research relevant to the target question were described. Firstly, from environmental psychology it was suggested that greater attention should be given to the subject's emotional response to the target stimuli, and that, from the connection between arousal and approach-avoidance, the use of negative emotive stimuli could on the whole be more likely to arouse our experimental participants and attract their attention than neutral or bland stimuli. Secondly, research on attention found that attention was attracted by stimuli which were relatively intense, bright, contrasting, colourful, novel, complex and incongruous - though only at moderate levels. Similarly, social psychology, using more complex and realistic settings than attention research, found that bright, moving, contrasting and novel stimuli attracted attention.

4. Some of the limitations of this paper were noted: there was a narrow focus on physical target characteristics without considering inevitable influences of properties of the perceiver and the environment on what aspects of the target stimuli would appear salient to any individual. Nevertheless, the findings presented here were valid in their relevance to considerations of the target question given that this paper does not present a comprehensive and exhaustive overview of the subject of targets in parapsychological research.

We have seen that there is some consistency in the suggestions of popular "psychic training" literature, spontaneous cases, and parapsychologists' theoretical ideas on the likely characteristics of successful GESP targets. These findings appear to suggest that our targets should be **psychologically salient** and **physically salient**: 1. targets in parapsychological research should be meaningful, have emotional impact and human interest - this may make them salient in the minds of our experimental participants; 2. targets should also be physically salient by standing out from their backgrounds - properties such as movement, novelty, complexity, incongruity, brightness and contrast tend to make stimuli physically salient.

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PSI COMMUNICATION IN THE GANZFELD

EXPERIMENTS WITH AN AUTOMATED TESTING SYSTEM AND A COMPARISON WITH A META-ANALYSIS OF EARLIER STUDIES

BY CHARLES HONORTON, RICK E. BERGER, MARIO P. VARVOGLIS, MARTA QUANT, PATRICIA DERR, EPHRAIM I. SCHECHTER, AND DIANE C. FERRARI

ABSTRACT: A computer-controlled testing system was used in 11 experiments on ganzfeld psi communication. The automated ganzfeld system controls target selection and presentation, subjects' blind-judging, and data recording and storage. Videotaped targets included video segments (dynamic targets) as well as single images (static targets). Two hundred and forty-one volunteer subjects completed 355 psi ganzfeld sessions. The subjects, on a blind basis, correctly identified randomly selected and remotely viewed targets to a statistically significant degree, $z = 3.89$, $p = .00005$. Study outcomes were homogeneous across the 11 series and eight different experimenters. Performance on dynamic targets was highly significant, $z = 4.62$, $p = .0000019$, as was the difference between dynamic and static targets, $p = .002$. Suggestively stronger performance occurred with friends than with unacquainted sender/receiver pairs, $p = .0635$. The automated ganzfeld study outcomes are compared with a meta-analysis of 28 earlier ganzfeld studies. The two data sets are consistent on four dimensions: overall success rate, impact of dynamic and static targets, effect of sender/receiver acquaintance, and prior ganzfeld experience. The combined z for all 39 studies is 7.53, $p = 9 \times 10^{-14}$.

Research on psi communication in the ganzfeld developed as the result of earlier research suggesting that psi functioning is frequently associated with internal attention states brought about

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through dreaming, hypnosis, meditation, and similar naturally occurring or artificially induced states (Braud, 1978; Honorton, 1977). This generalization, based on converging evidence from spontaneous case studies, clinical observations, and experimental studies, led to the development of a low-level descriptive model of psi functioning, according to which, internal attention states facilitate psi detection by attenuating sensory and somatic stimuli that normally mask weaker psi input (Honorton, 1977, 1978). This "noise-reduction" model thus identified sensory deprivation as a key to the frequent association between psi communication and internal attention states, and the ganzfeld procedure was developed specifically to test the impact of perceptual isolation on psi performance.

Fifteen years have passed since the initial reports of psi communication in the ganzfeld (Braud, Wood, & Braud, 1975; Honorton & Harper, 1974; Parker, 1975). Dozens of additional psi ganzfeld studies have appeared since then, and the success of the paradigm has triggered substantial critical interest. Indeed, there is at least one critical review or commentary for every ganzfeld study reporting significant evidence of psi communication (Akers, 1984; Alcock, 1986; Blackmore, 1980, 1987; Child, 1986; Druckman & Swets, 1988; Harley & Matthews, 1987; Harris & Rosenthal, 1988; Honorton, 1979, 1983, 1985; Hövelmann, 1986; Hyman, 1983, 1985, 1988; Hyman & Honorton, 1986; Kennedy, 1979; McClenon, 1986; Palmer, 1986; Palmer, Honorton, & Utts, 1989; Parker & Wiklund, 1987; Rosenthal, 1986; Sargent, 1987; Scott, 1986; Stanford, 1984, 1986; Stokes, 1986; Utts, 1986).

Of the many controversies spanning the history of parapsychological inquiry, the psi ganzfeld domain is unique in three respects. First, the central issue involves the replicability of a theoretically based technique rather than the special abilities of exceptional individuals (Honorton, 1977). Second, meta-analytic techniques have been used to assess statistical significance, effect size, and potential threats to validity (Harris & Rosenthal, 1988; Honorton, 1985; Hyman, 1985, 1988; Rosenthal, 1986). Third, investigators and critics have agreed on specific guidelines for the conduct and evaluation of future psi ganzfeld research (Hyman & Honorton, 1986).

The Automated Ganzfeld Testing System

Psi ganzfeld experiments typically involve four participants. The subject (or receiver, R) attempts to gain target-relevant imagery while in the ganzfeld; following the ganzfeld/imagery period, R tries—on a blind basis—to identify the actual target from among four possibilities. A physically isolated sender (Se) views the target and attempts to communicate salient aspects of it to R. Two experimenters (Es) are usually required. One E manages R, elicits R's verbal report of ganzfeld imagery (mentation), and supervises R's blind judging of the target and decoys; a second E supervises Se. and randomly selects and records the target.

We developed an automated ganzfeld testing system ("autoganzfeld") to eliminate potential methodological problems that were identified in earlier ganzfeld studies (Honorton, 1979; Hyman & Honorton, 1986; Kennedy, 1979) and to explore factors associated with successful performance. The system provides computer control of target selection and presentation, blind judging, subject feedback, and data recording and storage (Berger & Honorton, 1986). A computer-controlled videocassette recorder (VCR) accesses and automatically presents target stimuli to Se. A second E is required only for assistance in target selection The system includes an experimental design module through which E specifies the sample size and status of a new series.

The system was designed to enable further assessment of factors identified with successful performance in earlier ganzfeld studies. Differences in target type and sender/receiver acquaintance seem to be particularly important. Significantly better performance occurred in studies using dynamic rather than static targets. Dynamic targets contain multiple images reinforcing a central theme, whereas static targets contain a single image. Also, studies permitting subjects to have friends as their senders yielded significantly superior performance compared to those requiring subjects to work with laboratory senders. (See "Comparison of Study Outcomes with Ganzfeld Meta-Analysis" in the Results section.)

The autoganzfeld system uses both dynamic and static targets. The dynamic targets are excerpts from films; static targets include art work and photographs. Receivers may, if they choose, bring friends or family members to serve as their senders; a session setup module registers the sender type and other session information.

In this report, we present the results of the 11 autoganzfeld series conducted between the inauguration of the experiments in February, 1983, and September, 1989, when funding problems required suspension of the PRL research program.[1] We focus on

[1] This article conforms to the reporting guidelines recommended by Hyman and Honorton (1986). Because of the size of this database, however, it is not practical to

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(1) evidence for psi in the autoganzfeld situation, (2) the impact of dynamic versus static targets, (3) the effects of sender/receiver acquaintance, (4) the impact of prior psi ganzfeld experience, and (5) a comparison of these four factors with the outcomes of earlier nonautomated psi ganzfeld experiments. Our findings on demographic, psychological, and target factors will be presented in later reports.

Subjects

The participants are 100 men and 141 women ranging in age from 17 to 74 years (mean = 37.3, SD = 11.8). This is a well-educated group; the mean formal education is 15.6 years (SD = 2.0).

Our primary sources of recruitment include referrals from colleagues (24%), media presentations concerning PRL research (23%), friends or acquaintances of PRL staff (20%), and referrals from other participants (18%).

Belief in psi is strong in this population. On a seven-point scale where "1" indicates strong disbelief and "7" indicates strong belief in psi, the mean is 6.20 (SD = 1.03); only two participants rated their belief in psi below the midpoint of the scale. Personal experiences suggestive of psi were reported by 88% of the subjects; 80% reported ostensible telepathic experiences. Eighty percent of the participants have had some training in meditation or other techniques involving internal focus of attention.

Participant Orientation

Initial contact. New participants receive an information pack before their first session. The information pack includes a 55-item personal history survey (Participant Information Form [PIF]; Psychophysical Research Laboratories, 1983), Form F of the Myers-Briggs Type Indicator (MBTI; Briggs & Myers, 1957), general information about the research program, and directions for reaching PRL. Participants usually return the completed questionnaires before their first session. However, if new participants are scheduled on short notice, they either complete the questionnaires at PRL or, in a few cases, at home after the session.

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include the data in an appendix to the report. Instead, we will supply the data to qualified investigators in a Lotus-compatible, MS-DOS computer disk file. There is a small fee to cover materials and mailing. Address inquiries to the *Journal.*

Whenever possible, new participants are encouraged to come in for a preliminary orientation session, prior to their first PRL ganzfeld session. The orientation serves as a "get acquainted" session for participants and the PRL staff, and introduces participants to the PRL program and facility. Participants who avail themselves of this option generally complete the MBTI and PIF questionnaires during the orientation session. We inform new participants that they may bring a friend or family member to serve as their sender. When a participant chooses not to do so, a PRL staff member serves as sender. We encourage participants to reschedule their session rather than feel they must come in to "fulfill an obligation" if they are not feeling well.

Session orientation. We greet participants at the door when they arrive and attempt to create a friendly and informal social atmosphere. Coffee, tea, and soft drinks are available. E and other staff members engage in conversation with R during this period. When a laboratory sender is used, time is taken for sender and receiver to become acquainted.

If the participant is a novice, we describe the rationale and background of the ganzfeld research, and we seek to create positive expectations concerning R's ability to identify the target. This information is tailored to our perception of the needs of the individual participant, but it generally includes four elements: (1) a brief review of experimental, clinical, and spontaneous case trends indicating that ESP is more readily detected during internal attention states such as dreaming, hypnosis, and meditation (Honorton, 1977), (2) the notion that these states all involve physical relaxation and functional sensory deprivation, suggesting that weak ESP impressions may be more readily detected when perceptual and somatic noise is reduced, (3) the development of the ganzfeld technique to test this noise-reduction hypothesis, and (4) the long-term success of the ganzfeld technique as a means of facilitating psi communication in unselected subjects.

We encourage "goal orientation" and discourage excessive "task orientation" during the session; this is especially emphasized with participants who appear to be anxious or overly concerned about their ability to succeed in the ganzfeld task. We discourage participants from analyzing their mentation during the session, and tell them that they will have an opportunity to analyze their mentation during the judging procedure. They are encouraged to adopt the role of an outside observer of their mental processes during the ganzfeld. Again, this is emphasized with those who appear anxious

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about their performance; they are advised to relax, follow the taped instructions, and to simply allow the procedure to work. We inform participants that they may experience various types of correspondence between their mentation and the target; they are told that they may experience direct, literal correspondences to the target, but that they should also be prepared for correspondences involving distortions or transformations of the target content, cognitive associations, and similarities in emotional tone. Finally, we orient new participants to where Se and E will be located during the session.

METHOD

Layout and Equipment

R and Se are sequestered in nonadjacent, sound-isolated and electrically shielded rooms. Both rooms are copper-screened, and are 14 ft apart on opposite sides of E's monitoring room, which provides the only access. R and Se remain isolated in their respective rooms until R completes the blind-judging procedure.

R's room is an Industrial Acoustics Corp., IAC 1205A Sound-Isolation Room, consisting of two 4-inch sheetrock-filled steel panels. The two panels are separated by a 4-inch air space, for a total thickness of one foot.

The inside walls and ceiling of Se's room are covered with 4-inch Sonex® acoustical material, similar to that used in commercial broadcast studios. A free-standing Sonex-covered plywood barrier (5 ft wide by 8 ft high) positioned inside the sender's room, between Se's chair and the acoustical door, blocks sound transmission through the door frame. Figure 1 shows the floor plan of the experimental rooms.

E occupies a console housing the computer system and other equipment. The computer is an Apple II Plus with two disk drives, a printer, and an expansion chassis. The computer peripherals include a real-time clock, a noise-based random number generator (RNG), a Cavri Interactive Video Interface™, an Apple game paddle, and a fan. Other equipment includes a color TV monitor, the VCR used to access and display targets, and three electrically isolated audiocassette recorders. One audiocassette recorder presents audio stimuli (prerecorded relaxation exercises, session instructions, and white noise). Another plays background music during the experimental setup. The third records R's ganzfeld mentation and

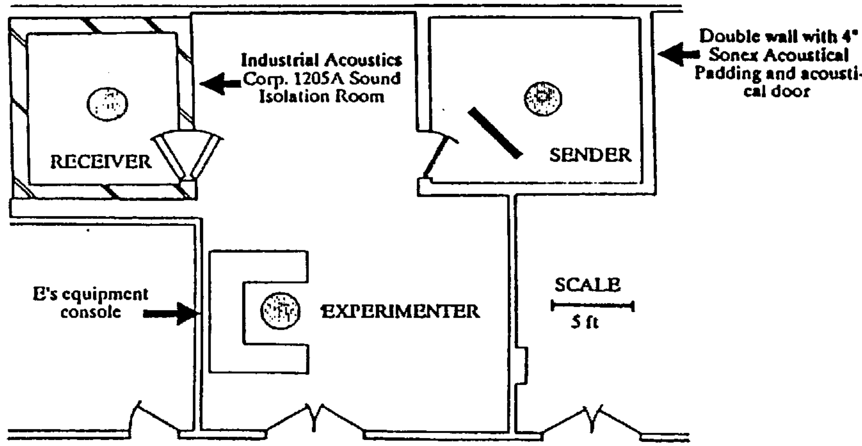

Figure 1. Floor plan of experimental suite.

judging period associations. There is two-way intercom communication between E and R. One-way audio communication from R to Se allows Se to listen to R's ganzfeld mentation.

Receiver Preparation

R sits in a comfortable reclining chair in the IAC room. Se keeps R company while E prepares R for visual and auditory ganzfeld stimulation. Translucent hemispheres are taped over R's eyes with Micropore® tape. Headphones are placed over R's ears. A clip-on microphone is fastened to R's collar. A 600-watt red-filtered floodlight, located approximately 6 ft in front of R's face, is adjusted in intensity until R reports a comfortable, shadow-free, homogeneous visual field. White noise level is similarly adjusted; R is informed that the white noise should be as loud as possible without being annoying or uncomfortable. The ganzfeld light and white noise intensity are adjusted from E's console after R and Se are sequestered in their respective rooms.

Sender Preparation

Se sits in a comfortable reclining chair in the sender's room. Se faces a color TV monitor, wearing headphones. During the session, Se can hear R's mentation report through one headphone; if dy-

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namic targets are used, Se hears the target audio channel through the other headphone.

Series Manager Setup Procedures

E accesses the autoganzfeld computer program through the *Series Manager* software. *Series Manager* is a password-protected, menu-driven control program. It provides the only means through which an experimenter may specify parameters for the series design, register new participants in the series, set up a session, and run a session. The *Series Manager* menu is accessed through entry of a private (and nonechoing) password.

Series design. A valid series design must exist before sessions can be run in an experimental series. This is done through the *Series Manager* "design" module. The design module prompts E to specify the type of series (pilot, screening, or formal), the number of participants, the maximum number of trials per participant, the total number of trials per series, and the series name. There is no provision for changing the series design once it is accepted by E. Design parameters are saved in a disk file; they are passed to the experimental program at the beginning of the session.

Participant registration. When R is new to a series, E accesses "Participant Registration" from the *Series Manager* menu before the session. E is prompted to enter R's name and identification number. The module verifies that the maximum number of participants specified in the design is not exceeded. (An error message appears if an attempt is made to register more participants than are specified in the design; then, control is returned to the *Series Manager* menu.)

Session setup. E then selects "Session Setup" from the *Series Manager* menu. E is prompted to enter R's name and the program verifies that R has not already completed the maximum number of trials specified in the design module. (An error message appears if a participant has completed the number of sessions allowed for the series or has not been properly registered; control is then returned to the *Series Manager* menu.) E enters Se's name and the sender type: lab, lab friend, or friend. *Lab senders* are PRL staff members whose acquaintance with the participant is limited to the experiment. *Lab friend* refers to PRL staff senders who have some social acquaintance with R outside the laboratory. *Friend senders* are friends or family members of the participant. Finally, E enters the ganzfeld light and noise intensity levels and his or her initials. E then leaves

the monitoring room while another PRL staff person supervises target selection.

Targets

The system uses short video segments (*dynamic targets*) and still pictures (*static targets*) as targets. Dynamic targets include excerpts from motion pictures, documentaries, and cartoons. Static targets include art prints, photographs, and magazine advertisements.

There are 160 targets, arranged in judging sets of four dynamic or four static targets. The sets were constructed to minimize similarities among targets within a set. The targets are recorded on four one-half-inch VHS format videocassettes; each videocassette contains 10 target sets (5 dynamic and 5 static). A signal recorded on an audio track of each videocassette allows computer access of the targets. Target display time—to Se during each sending period and to R during the judging period—is approximately one minute; blank space added to briefer targets insures that the VCR remains in play mode for the same length of time for all targets.

Preview packs. The video display format of the autoganzfeld targets does not permit simultaneous viewing of the entire target set during the judging procedure as is done in many nonautomated ganzfeld studies. Each target set is therefore accompanied by a preview pack containing brief excerpts of all four targets in the set; this gives R a general impression of the range of target possibilities. R views the preview pack at the beginning of the judging procedure; it runs approximately 30 sec.

Target Selection

The target selector (TS) is a PRL staff member who has no contact with either E or R until after the blind-judging procedure. TS is needed to load the videocassette containing the target into the VCR. TS is informed which of the four videocassettes contains the target, but remains blind to the target's identity. If Se is a staff member, Se serves this role; otherwise, a staff member not involved in the session serves as TS. (In the latter case, Se and R are sequestered in their respective rooms before TS enters the monitoring room.)

The *Series Manager* program prompts TS to press a key on the computer keyboard. A program call to the hardware RNG obtains the target value (a number between 1 and 160) and stores it in com-

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puter memory.[2] The program determines the target set and videocassette number from the target value. The videocassette number is displayed on the monitor, and TS is prompted to insert it into the VCR. The program verifies that the correct videocassette has been inserted and clears the monitor screen; if the videocassette is not correct, an error message prompts TS to insert the correct videocassette.

TS places a cardboard cover over the VCR's front panel to conceal the digital counters and VU meters. Finally, TS leaves the monitoring room with the three remaining videocassettes, knocking three times on the monitoring room door as a signal for E to return.

Relaxation Exercises and Ganzfeld Instructions

R and Se undergo a 14-min prerecorded relaxation exercise before the mentation/sending period. This provides a unique shared experience for R and Se before the ESP task. The relaxation exercise includes progressive relaxation exercises and autogenic phrases (Jacobson, 1929; Shultz, 1950). Ganzfeld instructions are recorded after the relaxation exercise. The instructions and relaxation exercise are delivered in a slow, soothing but confident manner with ocean sounds in the background. The style of presentation is similar to a hypnotic induction procedure. The ganzfeld instructions to R, which are also heard by Se, are as follows:

> During this experiment we want you to think out loud. Report all of the images, thoughts, and feelings that pass through your mind. Do not cling to any of them. Just observe them as they go by. At some point during the session, we will send you the target information. Do not try to anticipate or conjure up this information. Just give yourself the suggestion, right now—in the form of making a wish—that the information will appear in consciousness at the appropriate time. Keep your eyes open as much as possible during the session and allow your consciousness to flow through the sound you will hear through the headphones. One of us will be monitoring you in the other room. Now get as comfortable as possible, release all conscious hold of your body, and allow it to relax completely. As soon as you begin observing your mental processes, start thinking out loud. Continue to share your thoughts, images, and feelings with us throughout the session.

[2] An exception occurs in the two target comparison series (Series 301 and 302). See pp. 112–113.

Mentation/Sending Procedures

Receiver mentation report. After the relaxation exercise and instructions, R listens to the white noise through headphones for 30 minutes. R reports whatever thoughts, images, and feelings occur in the ganzfeld. The mentation report is monitored by E and Se from their respective rooms. The mentation report is tape recorded, and E takes detailed notes for review from R prior to judging.

Target presentation and sender procedures. A Cavri Video Interface automates computer access and control of targets from a JVC BR-6400U VCR. An electronic video switcher selectively routes the video output (VCR or computer text mode) to three color TV monitors, one each for E, R, and Se. E's and R's monitors remain in computer text mode until the judging period. During each of the six sending periods, Se's TV monitor is switched from computer text to VCR mode.

At the beginning of each sending period, Se's monitor displays the prompt, "Silently communicate the contents and meaning of the target to [R's first name]." Se views the target and attempts to communicate its contents to R. Se mentally reinforces R for target-related associations and mentally discourages R when the mentation is unrelated to the target.

Judging Procedure

After the mentation period, E turns off the ganzfeld light and reads back R's mentation from the session notes. R remains in ganzfeld during the mentation review to minimize any abrupt shift in state. E's and R's TV monitors are switched into VCR mode by the computer, which also prompts Se to "Silently direct [R's first name] to select the target that you saw." Se's TV monitor remains blank (computer mode) during this period.

R removes the eye covers and views the preview pack. From their respective rooms, R and E then view the four potential targets (the actual target and three decoys), which are presented in one of four random sequences. R, viewing each candidate, associates to the item as though it were the actual target, describing perceived similarities between the item and the ganzfeld mentation. While R associates to each candidate, E points out potential correspondences that R may have overlooked.[3] R views any of the target candidates as often as desired before proceeding to the judging task.

[3] This applies to Pilot Series 3, Novice Series 103–105, and to Experienced Series

A 40-point rating scale then appears on R's TV monitor. The scale is labelled 0% on the left and 100% on the right. Using a computer-game paddle to move a pointer horizontally across the rating scale, R indicates the degree of similarity between his ganzfeld mentation and each potential target. E and Se view R's ratings on their monitors. The program checks for ties, and, if they occur, R re-rates the four candidates to obtain unique ratings for each. The program then converts R's ratings into ranks. A rank of 1 is assigned to the candidate R believes has the strongest similarity to his ganzfeld mentation; a rank of 4 is given to the candidate R believes is least like his ganzfeld experience.

Feedback and Post-Session Procedures

After R finishes judging, Se leaves the sender's room and enters R's room with E. Se reveals the actual target, which the computer automatically displays on R's TV monitor. The session data are written to a floppy disk file.

Following feedback, E is prompted to backup the series data disk. The target videocassette is then automatically wound to a position near the center of the videocassette (frame 50,000). E selects "Analysis" from the *Series Manager* menu and obtains a hardcopy printout of the session data file. The printout includes: the file name, R's name and ID number, series type, session number, Se's name, E's initials, date and start time, target number, target position in the set, R's target ranking, the standardized target rating (z score), target judging sequence, target name, target type and set number, sender type, light and white noise levels, finish time, and optional experimenter's comments. The printout is attached to E's notes on R's mentation and placed in a ring binder containing all such information for the series. The audio tape of the session is similarly filed.

Experimenters

Eight Es contributed to the autoganzfeld database. Honorton, one of the originators of the psi ganzfeld technique, has conducted psi ganzfeld experiments over a 16-year period. Derr and Varvoglis worked with Honorton at Maimonides Medical Center and were trained by him. Berger is primarily responsible for the technical implementation of the autoganzfeld system. He trained Honorton, Derr, Varvoglis, and Schechter in its use. Honorton trained Quant, Ferrari, and Schlitz in the use of the autoganzfeld system.[1]

201 and 302. It does not apply to the earlier series (Pilot Series 1–2; Novice Series 101–102; or Experienced Series 301). This practice was initiated because participants frequently failed to identify obvious correspondences between their mentation and target elements.

Experimental Series

Altogether, 241 participants contributed 355 sessions in 11 series. To fully address the issue of selective reporting, we include every session completed from the inauguration of the experiments in February, 1983, to September, 1989, when the PRL facility was closed. Thus, this database has no "file-drawer" problem (Rosenthal, 1984).

The studies include three pilot series and eight formal series. Five of the formal series were single-session studies with novice participants. The remaining three formal series involved experienced participants.

Pilot Series

Series 1. This initial pilot series was conducted during the development and testing of the autoganzfeld system. It served to test system operation, to detect and correct programming errors, and to fine-tune session timing functions. Nineteen subjects contributed 22 sessions as Rs. Seven, including PRL staff members, had prior experience as Rs in nonautomated ganzfeld studies at Maimonides Medical Center. The remaining 12 Rs were novices with no prior ganzfeld experience. Series sample size was not specified in advance; the series continued until we were satisfied that the system was operating reliably.

Series 2. This pilot series was designed by Berger in an attempt to avert potential displacement effects and subject judging problems by having E rather than R serve as judge. R received feedback only to the actual target. Four participants contributed to this series. Nine of the planned 50 sessions were completed before Berger's departure from PRL when this series was discontinued.

[1] Berger, Schechter, and Varvoglis have doctorate degrees in psychology. Quant holds a masters degree in counselling psychology, and Ferrari has a bachelors degree in psychology. Schlitz has conducted independent ganzfeld and remote-viewing research in other laboratories and has a masters degree in anthropology.

Series 3. This pilot series was a practice series for participants who completed the allotted number of sessions in ongoing formal series but who wanted additional ganzfeld experience. This series also includes several demonstration sessions when TV film crews were present and provided receiver experience for new PRL staff. The sample size was not preset.

Novice ("First-Timers") Series

The identification of characteristics associated with successful initial performance was a major goal of the PRL ganzfeld project (Honorton & Schechter, 1987). Except for Series 105, each novice series includes 50 ganzfeld novices, that is, participants with no prior ganzfeld experience. Each novice contributed a single ganzfeld session. Most novices had not participated in *any* psi experiment prior to the novice series.

Series 101. This is the first novice series.

Series 102. Beginning with this series, R was prompted after the mentation period to estimate the number of minutes since the end of the relaxation/instructions tape.

Series 103. Starting with this series, Rs were given the option of having no sender (i.e., "clairvoyance" condition). Only four participants opted to have no sender.

Series 104. A visiting scientist (Marilyn Schlitz) served as E in seven sessions and as Se in six sessions with subjects from The Juilliard School in New York.

Series 105. This series was started to accommodate the overflow of Juilliard students from Series 104. The sample size was set to 25. Six sessions were completed at the time the PRL program was suspended. (There were 20 Juilliard students altogether. Sixteen were in Series 104 and four were in Series 105.)

Experienced Subjects Series

Series 201. This series involved especially promising subjects. The number of trials was set to 20. Seven sessions by three Rs were completed at the time the PRL program was suspended.

Series 301. This series compared dynamic and static targets. Sample size was set to 50 sessions. Twenty-five experienced subjects each contributed two sessions. The autoganzfeld program was modified for this series so that each R would have one session with dynamic targets and one session with static targets. Subjects were informed of this only after completing both sessions.

Series 302. This series used a single dynamic target set (Set 20). In earlier series, Target 77 ("Tidal Wave Engulfing Ancient City") had an especially strong success rate while Target 79 ("High-Speed Sex Trio") had never been correctly identified. We made two program modifications for this series. The target selection ("Randomize") routine was modified to select only targets in Set 20, and the VCR tape-centering routine was modified to wind the videotape to a randomly selected position between frame numbers 85,000 and 95,000. The second modification insured that E could not be cued, perhaps unconsciously, by the time required to wind the tape from its initial position to the target location.

The study involved experienced Rs who had no prior experience with Set 20. Each R contributed one session. Participants were unaware of the purpose of the study or that it was limited to one target set. The design called for the series to continue until 15 sessions were completed with each of the two targets of interest. Twenty-five sessions were completed when the PRL program was suspended.

Statistical Analysis

Except for two pilot series, series sample sizes were specified in advance. Our primary hypothesis was that the observed success rate—the proportion of correctly identified targets—would reliably exceed the null hypothesis expectation of .25. To test this hypothesis, we calculated the exact binomial probability for the observed number of direct hits (ranks of 1) with $p = .25$ and $q = .75$. On the basis of the overwhelmingly positive outcomes of earlier studies, we preset alpha to .05, one-tailed.

We also tested two secondary hypotheses, based on patterns of success in earlier psi ganzfeld research. These are: (1) that dynamic targets are significantly superior to static targets, and (2) that performance is significantly enhanced when the sender is a friend of R, compared to when R and Se are not acquainted. We initially planned to test these hypotheses by chi-square tests, a trial-based analysis. However, a consultant (Dr. Robert Rosenthal) suggested that a t test using the series as the unit would be a more powerful test of these hypotheses, and we have followed his recommendation. The remaining analyses are exploratory.[5]

[5] The statistical analyses in this report were performed using SYSTAT (Wilkin-

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TABLE 1
OUTCOME BY SERIES

Series	Series type	N subjects	N trials	Hits N	Hits %	Effect size (h)	Effect size z
1	Pilot	19	22	8	36	.25	.99
2	Pilot	4	9	3	33	.18	.25
3	Pilot	25	36	10	28	.07	.22
101	Novice	50	50	12	24	−.02	−.30
102	Novice	50	50	18	36	.24	1.60
103	Novice	50	50	15	30	.11	.67
104	Novice	50	50	18	36	.24	1.60
105	Novice	6	6	4	67	.87	1.78
201	Experienced	3	7	3	43	.38	.69
301	Experienced	25	50	15	30	.11	.67
302	Experienced	25	25	16	64	.81	3.93
	Overall	241	355	122	34	.20	3.89

Note. The z scores are based on the exact binomial probability with $p = .25$ and $q = .75$.

RESULTS

Overall Success Rate

Ganzfeld hit rate. There were 241 participants, who contributed 355 autoganzfeld sessions. The 122 direct hits (34.4%) yield an exact binomial p of .00005 ($z = 3.89$). The effect size, Cohen's h (Cohen, 1977), is .20. The 95% confidence interval (CI) is a hit rate from 30% to 39%. Because this level of accuracy would occur about one time in 20,000 by chance, we reject the null hypothesis. (See Table 1.)

Success rate by series. Of the 11 series, 10 yield positive outcomes. The mean series effect size is .29, $SD = .29$, $t\,(10) = 3.32$.

Homogeneity of effect sizes. Traditionally, psi investigators have been preoccupied by whether there is a significant nonzero effect. An equally important issue, however, is the size of the effect. There is a growing tendency among behavioral scientists to define replicability in terms of the homogeneity of effect sizes (Hedges, 1987; Rosenthal, 1986; Utts, 1986). Two or more studies are replicates of one another if their effect sizes are homogeneous. We assess the homogeneity of effect sizes across the 11 series by performing a chi-square homogeneity test comparing the effect size for each series with the weighted mean effect size (Hedges, 1981; Rosenthal, 1984). The formula is:

$$\chi^2(k-1) = \sum_{i=1}^{k} N_i(h_i - \bar{h})^2,$$

where k is the number of studies, N_i is the sample size of the ith study, and the weighted mean effect size is:

$$\bar{h} = \frac{\sum_{i=1}^{k} N_i h_i}{\sum_{i=1}^{k} N_i}.$$

The test shows that the series effect sizes are not significantly nonhomogeneous: $\chi^2 = 16.25$, 10 df, $p = .093$.

son, 1988). When t tests are reported on samples with unequal variances, they are calculated using the separate variances within groups for the error and degrees of freedom following Brownlee (1965). Combined zs are based on Stouffer's method (Rosenthal, 1984). Unless otherwise specified, p levels are one-tailed.

TABLE 2
OUTCOME BY EXPERIMENTER

Experimenter	N trials	Hits N	Hits %	Effect size (h)
Quant	106	38	36	.24
Honorton	72	27	38	.29
Berger	53	18	34	.20
Derr	45	12	27	.05
Varvoglis	43	11	26	.03
Schechter	14	5	36	.23
Ferrari	15	9	60	.72
Schlitz	7	2	29	.08

Homogeneity of Outcome by Experimenter

Eight Es contributed to the autoganzfeld database. (See Table 2.) All eight experimenters have positive effect sizes. A chi-square homogeneity test, using the mean effect sizes for each E weighted by sample size, indicates that the results are homogeneous across experimenters: $\chi^2 = 7.13$, 7 df, $p = .415$.

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TABLE 3
GANZFELD SUCCESS IN RELATION TO NUMBER OF SESSIONS

	No. of sessions as receiver			
	1	2	3	4 +
N subjects	183	23	24	11
N trials	183	46	72	54
Hits	53	19	31	19
% Hits	29	41	43	35
Effect size (*h*)	.09	.34	.38	.22

Subject-Based Analysis

Seventy-six percent of the participants ($N = 183$) contributed a single session as R. Fifty-eight Rs contributed multiple sessions. Participants with multiple sessions either had direct hits or strongly suggestive target mentation correspondences in their first session. (See Table 3.)

Success rate by subjects. To test the consistency of ganzfeld performance across participants, we use the standardized ratings of the target and decoys (Stanford's *z* scores; Stanford & Sargent, 1983) as the dependent variable. Stanford *z*s are averaged for participants with multiple sessions. Direct hits and Stanford *z*s are highly correlated. In this database, N (353) is .776. The mean Stanford *z* for the 241 participants is .21 ($SD = 1.04$), and $t(240) = 3.22$ ($p = .00073$). The 95% CI is a Stanford *z* from .08 to .35. The effect size (Cohen's *d*; Cohen, 1977) is .21. (The effect size for subjects is nearly identical to the trial-based effect size, $h = .20$.) Thus, there is a general tendency for participants to give higher ratings to the actual target than to the decoys, and the significance of these experiments is not attributable to exceptional performance by a few outstanding subjects.

Dynamic Versus Static Targets

The success rate for dynamic targets is highly significant. There are 190 dynamic target sessions and 77 direct hits (40%, $h = .32$; exact binomial $p = 1.9 \times 10^{-6}$, $z = 4.62$). The hit rate for static targets is not significant (165 trials, 45 hits, 27%, $h = .05$, $p = .276$, $z = .59$). Using the series effect size as the outcome variable and target type as the predictor variable, the point-biserial correlation (r_p) between ganzfeld performance and target type is .663, $t(17) =$ 3.65, $p = .002$.[6] The 95% CI for dynamic targets is a hit rate from 34% to 47%. The CI for static targets is from 21% to 34%. Thus, our hypothesis concerning the superiority of dynamic targets is strongly supported.

TABLE 4
SENDER/RECEIVER PAIRING

	Sender as:		
	Lab	Lab friend	Friend
N trials	140	66	145
N hits	46	24	52
% Hits	33	36	36
Effect size (*h*)	.18	.24	.24
z	2.01	1.93	2.83
p	.023	.026	.0023

Sender/Receiver Pairing

Receivers are more successful with friends than with laboratory senders, although the difference is not statistically significant. The number of sessions in this analysis is 351 because four subjects opted to have no sender. The best performance occurs with friend senders. Sessions with laboratory senders, although significant, have the lowest success rate. (See Table 4.)

Using series effect sizes as the unit of analysis and sender type as the predictor variable (combining lab friend and friends), r_p is .363, $t(17) = 1.61$, $p = .0635$.[7] The 95% CI for sessions with friends is a hit rate from 33.3% to 47%. For lab senders, the CI is from 18.3% to 41.8%. Thus, although the effect of sender type is not statistically significant, there is a trend toward better results with friends.

[6] Separate effect sizes were obtained for the dynamic and static target sessions of each series. Since Series 302 used dynamic targets only, the analysis is based on 11 dynamic target effect sizes and 8 static target effect sizes; two static target series (105 and 201) had extremely small sample sizes (2 and 3 sessions, respectively). A similar procedure is used in the analyses of sender/receiver pairing and experienced versus novice subjects.

[7] Three series involving laboratory senders were eliminated from this analysis because of extremely small sample sizes. These include Series 2 ($n = 2$), Series 105 ($n = 2$), and Series 201 ($n = 1$). Thus, the point biserial correlation is based on 11 series with friends and 8 series with laboratory senders.

Ganzfeld Experience

Two hundred and eighteen participants had their first experience as ganzfeld receivers in the autoganzfeld series. (This includes the 5 Novice Series 101–105 and 12 novices in Series 1.) For all but 24 (11%), their initial autoganzfeld session provided their first experience as participant in any parapsychological research. Of the 218 novices, 71 (32.5%, h = .17) correctly identified their target (exact binomial p = .0073, z = 2.44).

Participants with some ganzfeld experience contributed 137 trials and 51 hits (37%, h = .26, p = .001, z = 3.09). When series effect sizes are used as the unit of analysis and prior ganzfeld experience is used as the predictor variable, r_p is .078, t (10) = 0.25, p = .41. The 95% CI for novices is a hit rate from 25.5% to 49.5%. The CI for experienced participants is from 29% to 50%.

Participation by PRL Laboratory Staff

For completeness, we report the contribution of laboratory staff as subjects in this database. PRL staff members contributed 12 sessions as R. These sessions yield 3 hits (exact binomial p = .50; h = .00).

White Noise and Ganzfeld Illumination Levels

The mean white noise level (in arbitrary units of 0–7.5) is 2.97 (SD = 1.77). As measured from the headphones, the mean noise level is approximately 68 dB. The mean light intensity (arbitrary units of 0–100) is 73.8 (SD = 26.1). Preferred noise and light intensity levels are highly correlated: r = .569, t (353) = 12.99.

Neither noise nor light intensity is significantly related to ganzfeld performance. The point-biserial correlation between hits and noise level is −.026, t (353) = −0.48, p = .631, two tailed. For light intensity, r_p is −.040, t (353) = −0.76, p = .449, two tailed.

Randomness Tests

The adequacy of randomization was a major source of disagreement in two meta-analytic reviews of earlier psi ganzfeld research (Honorton, 1985; Hyman, 1985). In this section we document the adequacy of our randomization procedure according to guidelines agreed on by Hyman and Honorton (1986).

Global Tests of Random Number Generator

Full-range frequency analysis. As described earlier, autoganzfeld targets are selected through a program call to the RNG for values within the target range (1–160). The number of experimental sessions (N = 355) is too small to assess the RNG output distribution for the full range, so we performed a large-scale control series to test the distribution of values. Twelve control samples were collected. These included five samples with 156,000 trials, six samples with 1,560 trials, and one sample of 1,560,000 trials. The 12 resulting chi-square values were compared to a chi-square distribution with 155 df, using the Kolmogorov-Smirnov (KS) one-sample test. The KS test yields a two-tailed p = .577, indicating that the RNG used in these experiments provides a uniform distribution of values throughout the full target range.[8]

Test of frequency distribution for Set 20. We used a single target set (Set 20) in Series 302. We repeated the frequency analysis in a 40,000-trial control sample, restricting target selection to the four target values within Set 20 (Targets 77–80). A chi-square test of the distribution of targets within Set 20 shows that the RNG produces a uniform distribution of the target values within the set: χ^2 = 3.19, 3 df, p = .363.

Tests of the Experimental RNG Usage

Each autoganzfeld session required two RNG calls. An RNG call at the beginning of the session determined the target; another, made before the judging procedure, determined the order in which the target and decoys were presented for judging.

Distribution of targets in the experiment. A chi-square test of the distribution of values within the target sets shows that the targets were selected uniformly from among the four possibilities within each set; χ^2 with 3 df is 0.86, p = .835.

Distribution of judging order. A chi-square test of the judging order indicates that the targets were uniformly distributed among the four possible judging sequences: the χ^2 with 3 df is 1.85, p = .604.

[8] One of the preview pack elements for Set 6, containing Targets 21–24, was damaged. This required filtering the RNG calls in the experiment and control tests to bypass the damaged portion of the videotape, leaving the targets in Pool 6 unused. Thus, for the full-range analyses reported here, there are 155 df rather than 159.

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Summary

The randomness tests demonstrate that the RNG used for target selection in these experiments provides an adequate source of random numbers and was functioning properly during the experiments.

EXAMPLES OF TARGET-MENTATION CORRESPONDENCES

In this section, we present some examples of correspondences between targets and ganzfeld mentation. Although conclusions cannot be drawn from qualitative data, this material should not be ignored. It constitutes the raw data on which the objective statistical evidence is based, and may provide important insights concerning the underlying process. These examples are excerpts from sessions of subjects' ganzfeld mentation reports, identified by them during the blind judging procedure as providing their basis for rating the target.

Target 90, Static: Dali's "Christ Crucified."
Series 1. Participant ID: 77. Rank = 1. z score = 1.67.

"... I think of guides, like spirit guides, leading me and I come into like a court with a king. It's quiet.... It's like heaven. The king is something like Jesus. Woman. Now I'm just sort of summersaulting through heaven.... Brooding.... Aztecs, the Sun God.... High priest.... Fear.... Graves. Woman. Prayer.... Funeral.... Dark. Death.... Souls.... Ten Commandments. Moses...."

Target 77, Dynamic: Tidal wave engulfing ancient city. From "The Clash of the Titans," a film based on Greek mythology. A huge tidal wave crashes into the shore. The scene shifts to a center courtyard of an ancient Greek city; there is a statue in the center, and buildings with Greek columns around the periphery. People are running to escape consumption by the tidal wave. Water rushes through the buildings, destroying the columns and the statue; people scurry through a stone tunnel, just ahead of the engulfing water; debris floats through the water.
Series 1. Participant ID: 87. Rank = 1. z score = 1.42.

"... The city of Bath comes to mind. The Romans. The reconstruction of the baths through archaeology. The Parthenon. Also getting sort of buildings like Stonehenge but sort of a cross between Stonehenge and the Parthenon. The Byzantine Empire. The Gates of Thunder. The Holy See. Tables floating about.... The number 7 very clearly. That just popped out of nowhere. It reminds me a bit of one of the first *Clash* albums, however. The Clash, "*Two Sevens*" I think it was called, I'm not sure...." [The target was number 77.]

Series 302. Participant ID: 267. Rank = 1. z score = 2.00.

"... A big storm over New York City. I'm assuming it's New York City. No, it's San Francisco.... A big storm and danger. It looks so beautiful but I'm getting the sense of danger from it.... It's a storm. An earthquake...."

Target 63, Dynamic: Horses. From the film, "The Lathe of Heaven." An overhead view of five horses galloping in a snow storm. The camera zooms in on the horses as they gallop through the snow. The scene shifts to a close-up of a single horse trotting in a grassy meadow, first at normal speed, then in slow-motion. The scene shifts again; the same horse trotting slowly through empty city streets.
Series: 101. Participant ID: 92. Rank = 1. z score = 1.25.

"... I keep going to the mountains.... It's snowing.... Moving again, this time to the left, spinning to the left.... Spinning. Like on a carousel, horses. Horses on a carousel, a circus...."

Target 46, Dynamic: Collapsing Bridge. Newsreel footage of the collapse of a bridge the 1940s. The bridge is swaying back and forth and up and down. Light posts are swaying. The bridge collapses from the center into the water.
Series: 101. Participant ID: 135. Rank = 1. z score = 1.94.

"... Something, some vertical object bending or swaying, almost something swaying in the wind.... Some thin, vertical object, bending to the left.... Some kind of ladder-like structure but it seems to be almost blowing in the wind. Almost like a ladder-like bridge over some kind of chasm that's waving in the wind. This is not vertical this is horizontal.... A bridge, a drawbridge over something. It's like one of those old English type bridges that opens up from either side. The middle part comes up. I see it opening. It's opening. There was a flash of an old English stone bridge but then back to this one that's opening. The bridge is lifting, both sides now. Now both sides are straight up. Now it's closing again. It's closing, it's coming down, it's closed. Arc, images of arcs, arcs, bridges. Passageways, many arcs. Bridges with many arcs....

Target 137, Static: "Working on a Watermelon Farm." This painting shows a black man with his back to the picture; his suspenders form a V-shape

around his shoulders. A dog is in front of the man; there are watermelons between the dog and the man. The man faces a dirt path with watermelon patches on either side. On the left side, another man pushes a wheelbarrow filled with huge watermelons.
Series: 101. Participant ID: 105. Rank = 2. z score = 0.98.

". . . a small lamb, very soft, outside. Small, playful. . . . I see a 'V' shape. . . . An apple. . . . I see a kitchen towel with a picture on it. Apple seeds or a fruit cut in half showing the seeds. A tomato or an apple. The fruit was red on the outside. . . . I thought of watermelon as in a watermelon basket. Thinking of kids playing on a beach. Little kids playing with balls that are bigger than they are and buckets that are three-quarters their size. . . . I had a thought of going through a tunnel, not the kind of tunnel you see on Earth but the type of tunnel described when someone dies."

Target 64, Dynamic: 1920s Car Sinking. From the film "Ghost Story." The scene depicts the murder of a young blonde woman by three young men in the 1920s. The men are all wearing suits; one of the men is wearing a fedora hat that is turned up in the back. The men push an old car into a lake. The camera shifts between close-ups of their facial expressions, and the car, as it slowly sinks into the water. The woman's face and hand appear in the car's large rectangular rear window; she silently screams out for help. The car disappears beneath the water as the sequence ends.
Series: 102. Participant ID: 154. Rank = 1. z score = 1.45.

". . . Girl with a haircut. . . . Blond hair. . . . A car. . . . The back of someone's head. . . . Someone running to the right. . . . Someone on the right in a brown suit . . . and a fedora hat turned up very much in the back. . . . Fedora, trench coat, dark tie. . . . A tire of a car. The car's going to the left. An old movie. . . . I'm picturing an Edward G. Robinson movie. . . . Big roundish car like 1940's. Those scenes from the back window. Bumping once in a while up and down looking through the back window you could see that it was probably a big screen in back of the car and the car's standing still actually. . . . I think it's a movie I saw. They're being shot at and shooting at the window and then the girl gets shot. . . . Girl with the blonde haircut. . . . Someone walking in a suit, brown suit. . . . It's the 1940's again, 30's maybe. Except it looks like it's in color. Something red, blood . . . blood on someone's lap. . . . A dead person all of a sudden. . . . A big mouth opened. Yelling, but no sound. . . . Two people running near a train. . . . Dressed in 1920 type suits with balloony pants, like knickers. . . . A big, old-fashioned white car with a flat top. 1920's, 30's. . . ."

Target 107, Static: Stained-Glass Madonna with Child. This is a stained-glass window depicting the Virgin Mary and Christ child.

Series: 102. Participant ID: 183. Rank = 2. z score = 0.61.

"Some kind of a house, structure. . . . Some kind of wall or building. Something with the sky in the background. Thinking of a bell. A bell structure. Something with a hole with the light coming through the hole. . . . Like a stained glass window like you see in churches."

Target 19, Static: Flying Eagle. An eagle with outstretched wings is about to land on a perch; its claws are extended. The eagle's head is white and its wings and body are black.
Series: 104. Participant ID: 316. Rank = 1. z score = 2.00.

". . . A black bird. I see a dark shape of a black bird with a very pointed beak with his wings down. . . . Almost needle-like beak. . . . Something that would fly or is flying . . . like a big parrot with long feathers on a perch. Lots of feathers, tail feathers, long, long, long. . . . Flying, a big huge, huge eagle. The wings of an eagle spread out. . . . The head of an eagle. White head and dark feathers. . . . The bottom of a bird. . . ."

Target 144, Dynamic: Hell. From the film "Altered States." This sequence depicts a psychedelic experience. Everything is tinted red. The rapidly shifting scenes include: A man screaming; many people in the midst of fire and smoke; a man screaming in an isolation tank; people in agony; a large sun with a corona around it; a mass crucifixion; people jumping off a precipice, in the midst of fire, smoke, and molten lava; spiraling crucifixes. There is a close-up of a lizard's head, slowly opening its mouth, at the end of the sequence.
Series: 104. Participant ID: 321. Rank = 1. z score = 1.49.

". . . I just see a big 'X'. A big 'X'. . . . I see a tunnel in front of me. It's like a tunnel of smog or a tunnel of smoke. I'm going down it. . . . I'm going down it at a pretty fast speed. . . . I still see the color red, red, red, red, red, red, red, red. . . . Ah, suddenly the sun. . . . The kind of cartoon sun you see when you can see each pointy spike around the sphere. . . . I stepped on a piece of glass and there's a bit of blood coming out of my foot. . . . A lizard, with a big, big, big head. . . ."

Target 148, Static. Three Unusual Planes. Three small aircraft flying in formation. The planes are white and have swept-back wings; their landing-gear is extended. A winding road is visible below.
Series: 104. Participant ID: 322. Rank = 2. z score = 0.39.

". . . A jet plane. . . . A 747 on the way to Greece. Blue skies. Sounds like it's going higher. . . . I think I'm back on the plane again. I never used to be afraid of flying until recently. . . . They need better insulated jets, soundproof like these rooms. They could use these comfortable seats, too. And the leg room. The service isn't bad either. . . . Still can't get the feeling of being in an airplane out of my mind. Flying over Greenland and Iceland when I went to England.... Feels like we're going higher and higher.... Descending. It seems we're descending.... Big airplanes flying over with people like me staring down.... Flying around in a piece of tin.... Feel like I'm getting a G-force. Maybe I am taking off. Sure feels like it. Feels like we're going straight up.... I always feel like when I'm on the plane going home, I just hope that plane makes it past the Rocky Mountains...."

Target 10, Static: Santa and Coke. This is a Coca-Cola Christmas ad from the 1950s, showing Santa Claus holding a Coke bottle in his left hand; three buttons are visible on Santa's suit. Behind Santa and to his left, is a large bottle cap with the Coca-Cola logo leaning against an ornamented Christmas tree.
Series: 104. Participant ID: 332. Rank = 1. z score = 1.14.

"... There's a man with a dark beard and he's got a sharp face.... There's another man with a beard. Now there's green and white and he's in bushes and he's sort of colonial. He looks like Robin Hood and he's wearing a hat.... I can see him from behind. I can see his hat and he has a sack over his shoulder.... Window ledge is looking down and there's a billboard that says 'Coca-Cola' on it.... There's a snowman again and it's got a carrot for a nose and three black buttons coming down the front.... There's a white beard again. There's a man with a white beard.... There's an old man with a beard...."

Target 70, Dynamic: Dancing in NY City Streets. From the film "The Wiz." The span of yellow-paved bridge over a body of water and automobile traffic is visible in the opening scene; the New York City skyline is in the background. A hot-air balloon flies overhead. The scene shifts as Dorothy (Diana Ross), her dog Toto, the Lion, Tin Man, and Scarecrow dance along the bridge; one of the bridge's supporting arches is behind them. The Chrysler Building is in the background. At the end of the sequence, the characters dance in front of a painted backdrop of an old-fashioned building.
Series: 105. Participant ID: 336. Rank = 1. z score = 1.40.

"Big colorful hot air balloons.... White brick wall.... Ocean.... People walking before my eyes. Several people.... A dog. Hot air balloon.... a nightclub singer.... Back of a woman's head, short curly hair.... Water.... Balloon, big balloon.... Yellow.... Very tall building. Looking down at a city. Leaving a city, going up.... Faces. An arc.... Water.... A woman's face.... Cars, freeway.... A rock-n-roll star chanting.... Architecture. A jester's hat.... geometrical figures, designs. ... Yellow chocolate bar. Water. Going down into water, deep down.... Man with long golden hair and sun glasses.... The Bay, San Francisco

Bay. A lion.... Highways.... Lion, see a lion.... Tornado.... Balloon.... Face mask.... City.... Leaning Tower of Pisa.... Long hallway, doorway.... Long road. Long, long desert road...."

Target 22, Dynamic: Spiders. From the documentary "Life on Earth." A spider is weaving its web. The spider's long legs spring up and down repeatedly, weaving strands of the web. The body of the spider is constantly in motion, and bounces up and down. A close-up shows one of the veins of the web being stretched out by the spider. Various views of the web.
Series: 301. Participant ID: 146. Rank = 2. z score = 0.65.

"... Now visual patterns more like a spider web and the color. And then like the form of the veins of a windmill.... Something like a spider web again. A spider web. A pattern that instead of a spider web it looks like basket weaving.... An image of the way some children were able to do something like flying when I was a child though I never had one. It was a—forgotten what it was called—a pogo stick or a jump stick, something in which you jumped up and down and you could hop quite a distance by doing so.... I have kinesthetic images all over as in vigorous motion expressed in flying or jumping on this sort of spring stick that I mentioned.... Vigorous motion. It's as though I were trying to combine relaxation with participating in an image of something very vigorous.... I really feel carried away by these images of vigorous activity without being able to localize this activity as to what it is...."

Target 108, Static: Two fire eaters. A young fire eater, in the foreground, facing to the right of the picture, blows a huge flame out of his mouth. In the background there is another fire eater. A group of people are watching on the left side of the picture.
Series: 301. Participant ID: 146. Rank = 1. z score = 1.71.

"... I keep having images of flames now and then.... The sound reminds me of flames too.... I find flames again.... In these new images the fire takes on a very menacing meaning.... Rather mountainous sticking up of bare rocks just as though they had come from a recently formed volcano. Volcanos of course get back to the fire, extreme heat. I had an image of a volcano with molten lava inside the crater. Molten lava running down the side of the volcano.... Cold. Written out there behind the visual field and thinking how it contrasts with my images of flames. Although my images of flames didn't actually include much real feeling of heat. I didn't have any imagery of heat in connection with the flames. Just abstract thought of flames.... Now I think of the water as a way of putting out flames. Suddenly, I was biting my lip. Biting my lip as though lips had something to do with the imagery and I see lips out in front of me.... And the lips I see are bright red, reminding me of the flame imagery earlier. And then a bright heart such as Valentine's candy in the shape of a heart. The cinnamon flavored candies that I remember as a child having at Valentine's. Red color.... This red as in the cinnamon candy is a deep very intense red. And similarly for the flames. And now I see the word 'red'...."

Target 94, Dynamic: Hang Gliders. The sequence shows a skier on a V-shaped hang glider. The skier soars high up above snow covered mountains and a pine forest. At the end, the skier lands on a mountain slope and skis away. The sequence is accompanied by Pachelbel's Canon.
Series: 301. Participant ID: 188. Rank = 1. z score = 1.26.

"...Some kind of 'V' shape, like an open book.... I get some mountain.... Some kind of bird with a long wing.... The shape of an upside down 'V'.... Ski, something about skiing came to me.... Some kind of body like an oval shape of a body with wings on top of it in a 'V' shape. Another 'V' like a wing shape.... Something with wings.... Again the shape of an umbrella came into my mind. A butterfly shape...."

Target 80, Dynamic: Bugs Bunny in Space. In this cartoon, there is a close-up of the lower part of a cigar-shaped rocketship and the supports holding it up. The rocket assembly slides over to the launching pad, directly above Bugs Bunny's underground patch. The scene shifts to the underground patch, as Bugs Bunny climbs up the ladder leading out of his patch. Unknowingly, he climbs up through the interior of the rocketship. The rocket's supports pull away and then it takes off into space. The rocket's nose cone spins as Bugs Bunny appears through the top and he sees the Earth recede rapidly in the distance. As the sequence ends, Bugs Bunny is hit in the belly by a comet.
Series: 302. Participant ID: 292. Rank = 1. z score = 1.48.

"...Space craft.... The solar system. The underside of a helicopter or a submarine or some kind of fish that you're seeing from underneath.... Sort of being underneath it. Sort of being underneath it.... A very strange image like a cartoon character, animated character. With his mouth open kind of.... Like a hypodermic needle or a candle or this shaft like thing with the a pointed top again.... missiles flying.... An aerial perspective.... I'm just kind of editing here I think. I'm really hoping all this rocketship kind of imagery isn't because of the noise. I feel like I'm in a rocketship or something.... That image of the ship going into the belly of the mother ship...."

Comparison of Study Outcomes with Ganzfeld Meta-Analysis

In this section, we compare the automated ganzfeld study outcomes with the results of earlier ganzfeld studies, summarized in a

Table 5

Comparison of Overall Performance in Automated Ganzfeld and Meta-Analysis Data Sets

Outcome variable	Database	N studies	Mean	SD	t	df	p
z scores	Meta-analysis	28	1.25	1.57	0.33	25	.748
	Autoganzfeld	11	1.10	1.14			
Effect sizes (h)	Meta-analysis	28	.28	.46	0.14	28	.892
	Autoganzfeld	11	.29	.29			

Note. The p values are two-tailed.

meta-analysis (Honorton, 1985). We compare the two databases on four dimensions: (1) overall success rate, (2) dynamic versus static targets, (3) sender/receiver pairing, and (4) novice versus experienced subjects.

Overall Success Rate

To assess the consistency of results, we compare the 11 autoganzfeld series to the 28 studies in a meta-analysis of earlier ganzfeld studies (Honorton, 1985, Table A1, p. 84), using direct hits as the dependent variable. The outcomes of the two data sets are consistent. Both display a predominance of positive outcomes: 23 of the 28 studies in the meta-analysis (82%) and 10 of the 11 autoganzfeld series (91%) yield positive z scores. The mean autoganzfeld z scores and effect sizes are very similar to those in the meta-analysis. (See Table 5.)

Combined Estimates of Ganzfeld Success Rate

Because the z scores and effect sizes for the automated ganzfeld are consistent with the original set of 28 studies in the meta-analysis, a better estimate of their true population values may be obtained by combining them. Positive outcomes were obtained in 33 of the 39 studies (85%); the 95% CI is from 69% to 99%. Table 6 shows a stem-and-leaf frequency plot of the z scores (Tukey, 1977). Unlike other methods of displaying frequency distributions, the stem-and-leaf plot retains the numerical data precisely. (Turned on its side, the stem-and-leaf plot becomes a conventional histogram.) Each number includes a stem and one or more leaves. For example, the stem 1 is followed by leaves of 6,6,6,7,7,7, representing z scores of 1.6,1.6,1.6,1.7,1.7,1.7. In the display, the letter "H" identifies the

TABLE 6
DISTRIBUTION OF z SCORES

Stem		Leaf			
			Minimum z	=	−1.97
−1.		97	Lower hinge	=	0.25
−0.		85	Median z	=	0.92
−0.		33	Mean z	=	1.28
0.	H	222224	Upper hinge	=	2.08
0.	M	6667777999	Maximum z	=	4.02
1.		666777	*SD*	=	1.44
2.	H	011	Skewness (g_1)	=	0.05
2.		8	Kurtosis (g_2)	=	−0.37
3.		01124	Combined (Stouffer) z	=	7.53
3.		9			
4.		0			

upper and lower hinges of the distribution, and "M" identifies its median. The z's range from −1.97 to 4.02 (mean z = 1.21, *SD* = 1.45), and the 95% CI is a z from .76 to 1.66.

The combined z for the 39 studies is 7.53 ($p = 9 \times 10^{-14}$). Rosenthal's (1984) file-drawer statistic indicates that 778 additional studies with z scores averaging zero would be required to reduce the significance of the combined ganzfeld database to nonsignificance; that is a ratio of 19 unknown studies for every known study.

A stem-and-leaf display of the effect sizes is shown in Table 7. The effect sizes range from −.93 to 1.44 (mean *h* = .28, *SD* = .41). The two most extreme values on both sides of the distribution are outliers. The 95% CI is an *h* between .15 and .41; the equivalent hit rate is from 31.5% to 44.5%.

Dynamic Versus Static Targets

The use of video sequences as targets is a novel feature of the autoganzfeld database. However, a comparable difference in target type exists in the earlier ganzfeld studies. Of the 28 direct hits studies in the meta-analysis, 9 studies (by three independent investigators) used *View Master* stereoscopic slide reels as targets (Honorton, 1985, Studies 7–8, 16–19, 21, 38–39). Static targets (single pictures or slides) were used in the remaining 19 studies by seven independent investigators (Studies 1, 2, 4, 10–13, 23–31, 33–34, 41–42). Like the autoganzfeld video sequences, *View Master* targets present a variety of images reinforcing a central target theme.

TABLE 7
DISTRIBUTION OF EFFECT SIZES (COHEN'S *h*)

Stem		Leaf			
−.9		3			
−.4		0			
OUTSIDE VALUES					
			Minimum *h*	=	−0.93
−.3		1	Lower hinge	=	0.10
−.1		0	Median *h*	=	0.25
−.0		51	Mean *h*	=	0.28
.0		7779	Upper hinge	=	0.41
.1	H	002888	Maximum *h*	=	1.44
.2	M	1334	*SD*	=	0.41
.3		11144777	Skewness (g_1)	=	0.28
.4	H	01113	Kurtosis (g_2)	=	2.49
.5		7			
.7		3			
.8		17			
OUTSIDE VALUES					
1.3		3			
1.4		4			

To compare the relative impact of dynamic and static targets in the autoganzfeld and meta-analysis, we obtained point-biserial correlations for each data set using target type (static or dynamic) as the predictor variable and the series effect size, Cohen's *h*, as the outcome variable. We test the difference between the two correlations using Cohen's *q* (Cohen, 1977). Dynamic targets yield significantly larger effect sizes in both data sets. For the meta-analysis, r_p is .409, t (26) = 2.28, p = .015; and for the autoganzfeld, as reported above, r_p is .663. The two correlations are not significantly different (q = .36; z = 1.14). Therefore, we combine the two data sets to obtain a better estimate of the relationship between effect size and target type: r_p = .439, t (45) = 3.28, p = .002. The 95% CIs are 24% to 36% for static targets and 38% to 55% for dynamic targets. Thus, the cumulative evidence strongly indicates that dynamic targets are more accurately retrieved than static targets.

Sender/Receiver Pairing

A similar analysis compares the effects of sender/receiver pairing in the two databases. Studies in the meta-analysis did not routinely

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provide detailed breakdowns regarding sender/receiver pairing. Sender/receiver pairing in the meta-analysis can only be coded according to whether subjects could bring friends to serve as their sender or were restricted to laboratory senders. In 17 studies, by six independent investigators, subjects were free to bring friends (Honorton, 1985, Studies 1–2, 4, 7–8, 16, 23–28, 30, 33–34, 38–39). Laboratory-assigned senders were used exclusively in the remaining 8 studies, by four independent investigators (Studies 10–12, 18–19, 21, 29, 41). (Three studies using clairvoyance procedures and no senders are excluded from this analysis.) For the autoganzfeld studies, we calculated separate effect sizes for each series by sender type (combining lab friend and friend for comparability with the meta-analysis). In the meta-analysis, r_p (23) is .403; larger effect sizes occurred in studies where friends could serve as sender (t = 2.11, p = .023). For the autoganzfeld, as reported above, r_p is .363, in the same direction. The two correlations are very similar (q = .05; z = 0.14) and are combined to give a better estimate of the relationship between sender/receiver pairing and ganzfeld study outcome: r_p = .38, t (42) = 2.66, p = .0055. The 95% CIs are 20% to 34% for unacquainted sender/receiver pairs and 34.1% to 49.2% for friends. Thus, the sender/receiver relationship does have a significant impact on performance.

Effect of Prior Ganzfeld Experience

The meta-analysis includes 14 studies, by nine independent investigators, in which novices are used exclusively (Honorton, 1985, Studies 2, 4, 8, 10–12, 16–18, 23–24, 31, 41–42). Experienced or mixed samples of novice and experienced subjects are used in the remaining 14 studies, by four different investigators (Studies 1, 7, 9, 21, 25–30, 33–34, 38–39). Studies using experienced subjects were more successful than those limited to novices; the point-biserial correlation between level of experience and effect size is .229, t (26) = 1.20, p = .12. For the autoganzfeld studies, as reported above, r_p is .078. The two correlations do not differ significantly (q = .155; z = 0.40), and the combined r_p is .194, t (38) = 1.22, p = .105. The respective 95% CIs are 24.5% to 44.5% for novices and 35.5% to 48% for experienced subjects.

The 95% CIs for these comparative analyses are shown graphically in Figure 2. The bottom two rows are CIs for the overall hit rates in the meta-analysis and autoganzfeld, respectively. The next two rows give the CIs for dynamic targets in the two data sets, and so on.

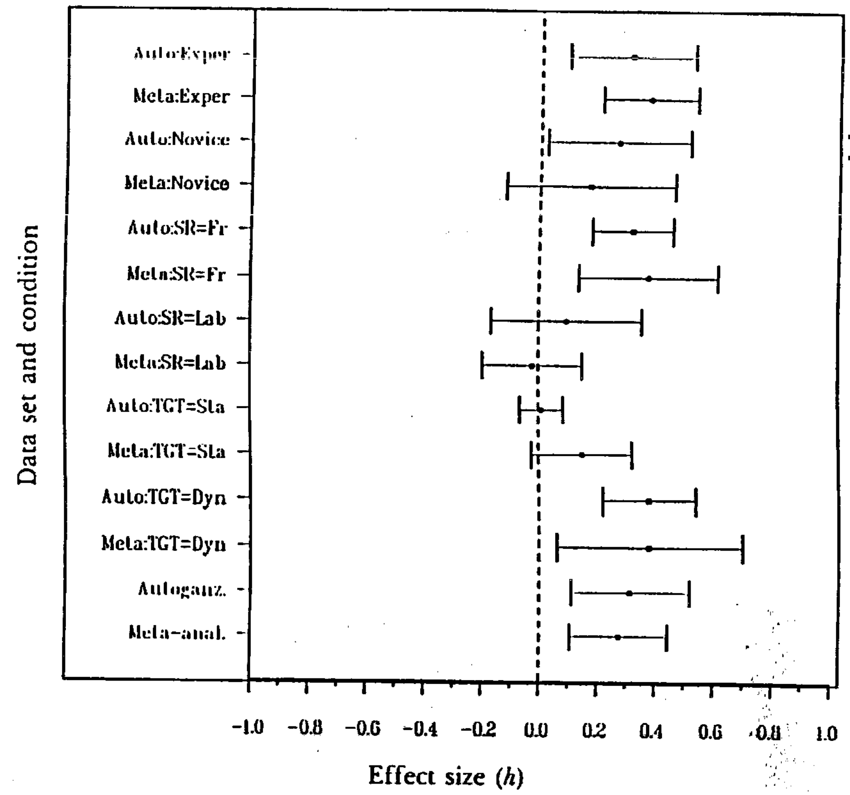

Figure 2. Comparison of autoganzfeld and meta-analysis 95% confidence limits. Abbreviations are defined as follows: Meta = meta-analysis studies, Auto = automated ganzfeld studies, Dyn = dynamic targets, Sta = static targets, Lab = laboratory senders, Fr = sender is friend or acquaintance of receiver, Novice = no prior ganzfeld experience, Exper = prior ganzfeld experience.

Discussion

We now consider various rival hypotheses that might account for the experimental outcomes, and the degree to which the automated ganzfeld experiments, viewed in conjunction with the earlier psi ganzfeld studies, constitute evidence for psi communication. Finally, we consider directions for future research suggested by these findings.

Rival Hypotheses

Sensory Cues. Only Se knows the identity of the target until R finishes the automated judging procedure. If Se is not a PRL staff member, a staff member not otherwise involved in the session supervises target selection. In either case, the target selector knows only which videocassette contains the target. The target selector leaves the monitoring room with the remaining three target tapes after knocking three times on the monitoring room door, signalling E to return. Since the target selector only knows the videocassette number, variations in knocking cannot communicate any useful information to E. The cardboard cover over the VCR eliminates any visual cues to E regarding the position of the videotape or the activity of the VU meters (which are active when the target is dynamic and has a soundtrack).

Sensory transmission from Se to R during the ganzfeld session is eliminated by having R and Se in separate, sound-attenuated rooms. If either participant leaves their room before R's ratings have been registered in the computer, the session is unconditionally aborted.

The videotape target display system prevents potential handling cues during the judging procedure. Computer registration of R's target ratings and automated feedback after the session prevents the possibility of cheating by Se during feedback, raised by Hyman (1985).

After about 80% of the sessions were completed, it was becoming clear that our hypothesis concerning the superiority of dynamic targets over static targets was receiving substantial confirmation. Because dynamic targets contain auditory as well as visual information, we conducted a supplementary test to assess the possibility of auditory leakage from the VCR soundtrack to R. With the VCR audio set to normal amplification, no auditory signal could be detected through R's headphones, with or without white noise. When an external amplifier was added between the VCR and R's headphones and with the white noise turned completely off, the soundtrack could sometimes be faintly detected. It is unlikely that subjects could have detected any target audio signal with the normal VCR amplification and white noise; as we have reported, there is no correlation between ganzfeld success rate and white noise level in these exper-

iments. Nevertheless, to totally exclude any possibility of subliminal cueing, we modified the equipment. Additional testing confirmed that this modification effectively eliminated all leakage. This was formally confirmed by an audio spectrum analysis, covering the frequency domain between 475 Hz and 15.2 kHz. The critical question, of course, is whether performance on dynamic targets diminished after this modification. The answer is no; in fact, performance improved. Before the modification, the direct hit rate on dynamic targets was 38% (150 trials, 57 hits, h = .28, exact binomial p = .00029, z = 3.44); the 95% CI was from 31% to 45%. Following the modification, the direct hit rate was 50% (40 trials, 20 hits, h = .52, exact binomial p = .00057, z = 3.25) with a 95% CI from 37% to 63%. The direct hit rate for all targets—static and dynamic—after the modification was 44% (64 trials, 28 hits, h = .39, exact binomial p = .00082, z = 3.15).

Randomization. As Hyman and Honorton (1986, p. 357) have pointed out, "Because ganzfeld experiments involve only one target selection per session . . . , the ganzfeld investigator can restrict his or her attention to a frequency analysis allowing assessment of the degree to which targets occur with equal probability." We have documented both the general adequacy of the RNG used for target selection and its proper functioning during the experiment.

Data selection. Except for two pilot studies, the number of participants and trials were specified in advance for each series. The pilot or formal status of each series was similarly specified in advance and recorded on disk before beginning the series. We have reported all trials, including pilot and ongoing series, using the automated ganzfeld system. Thus, there is no "file-drawer" problem in this database.

Psi ganzfeld success rate is similar for pilot and formal sessions. The proportion of hits for the 66 pilot sessions is .32 (h = .16, p = .129, z = 1.13). For the 289 formal sessions, the proportion correct is .35 (h = .22, p = .0001, z = 3.71). The difference is not significant: $\chi^2 = 0.11$, 1 df, p = .734.

If we assume that the remaining trials in the three unfinished series would yield only chance results, these series would still be statistically significant (exact binomial p = .009, z = 2.36). This would reduce the overall z for all 11 series from 3.89 to 3.61. Thus, inclusion of the three incomplete studies does not pose an optional stopping problem.

Multiple analysis. Informal examination of recent issues of several American Psychological Association journals suggests that correction for multiple comparisons is not a common practice in more conventional areas of psychological inquiry. Nevertheless, half of Hyman's (1985) 50-page critique of earlier psi ganzfeld research focused on issues related to multiple testing. In the present case, advance specification of the primary hypothesis and method of analysis prevents problems involving multiple analysis or multiple indices in our test of the overall psi ganzfeld effect. Our direct hits analysis is actually less significant than either the sum of ranks method ($z = 4.04$, $p = 2.7 \times 10^{-5}$) or Stanford's z scores ($t = 4.53$, 354 df, $p = 4.1 \times 10^{-6}$).

In addition to the primary hypothesis, however, we also tested two secondary hypotheses concerning the impact of target type and sender/receiver pairing on psi performance, and we have presented several purely exploratory analyses as well. Our Results section includes 15 significance tests involving psi performance as the dependent variable, and the p values cited are not adjusted for multiple comparisons. Of the 15 significance tests, 9 are associated with $p < .05$. The Bonferroni multiple comparisons procedure provides a conservative method of adjusting the alpha level when several simultaneous tests of significance are performed (Holland & Copenhaver, 1988; Hyman & Honorton, 1986; Rosenthal & Rubin, 1984). When the Bonferroni adjustment is applied, six of the nine individually significant outcomes remain significant; these are: the overall hit rate, the subject-based analysis using Stanford z scores, the difference between dynamic and static targets, the dynamic target hit rate, and the hit rate for experienced subjects.

Although the relationship between psi performance and sender type is not independently significant in the autoganzfeld, the correlation coefficient of .363 is close to that observed in the meta-analysis ($r = .403$), and the combined result is significant. The cumulative evidence, therefore, does support the conclusion that the sender/receiver relationship is a significant moderator of ganzfeld psi performance.

Security. Given the large number of subjects and the significance of the outcome using subjects as the unit of analysis, subject deception is not a plausible explanation. The automated ganzfeld protocol has been examined by several dozen parapsychologists and behavioral researchers from other fields, including well-known critics of parapsychology. Many have participated as subjects, senders, or observers. All have expressed satisfaction with our handling of security issues and controls.

In addition, two experts on the simulation of psi ability have examined the autoganzfeld system and protocol. Ford Kross has been

a professional mentalist for over 20 years. He is the author of many articles in mentalist periodicals and has served as Secretary/Treasurer of the Psychic Entertainers Association. Mr. Kross has provided us with the following statement: "In my professional capacity as a mentalist, I have reviewed Psychophysical Research Laboratories' automated ganzfeld system and found it to provide excellent security against deception by subjects" (personal communication, May, 1989). We have received similar comments from Daryl Bem, Professor of Psychology at Cornell University. Professor Bem is well known for his research in social and personality psychology. He is also a member of the Psychic Entertainers Association and has performed for many years as a mentalist. He visited PRL for several days and was a subject in Series 101.

The issue of investigator integrity can only be conclusively addressed through independent replications. It is, however, worth drawing attention to the 13 sessions in which a visiting scientist, Marilyn J. Schlitz, served as either experimenter ($N = 7$, 29% hits, $h = .08$) or sender ($N = 6$, 67% hits, $h = .36$). Altogether, these sessions yielded 6 direct hits ($N = 13$, 46.2% hits, $h = .45$). This effect size is more than twice as large as that for the database as a whole.

Status of the Evidence for Psi Communication in the Ganzfeld

The automated ganzfeld studies satisfy the methodological guidelines recommended by Hyman and Honorton (1986). The results are statistically significant. The effect size is homogeneous across 11 experimental series and eight different experimenters. Moreover, the autoganzfeld results are consistent with the outcomes of the earlier, nonautomated ganzfeld studies; the combined z of 7.53 would be expected to arise by chance less than one time in 9 trillion.

We have shown that, contrary to the assertions of certain critics (Druckman & Swets, 1988, p. 175), the ganzfeld psi effect exhibits "consistent and lawful patterns of covariation found in other areas of inquiry." The automated ganzfeld studies display the same patterns of relationships between psi performance and target type, sender/receiver acquaintance, and prior testing experience found in earlier ganzfeld studies, and the magnitude of these relationships is consistent across the two data sets. The impact of target type and sender/receiver acquaintance is also consistent with patterns in spontaneous case studies, linking ostensible psi experiences to emotionally significant events and persons. These findings cannot be ex-

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plained by conventional theories of coincidence (Diaconis & Mosteller, 1989).

Hyman and Honorton (1986) have stated,

> ...the best way to resolve the [ganzfeld] controversy...is to await the outcome of future ganzfeld experiments. These experiments, ideally, will be carried out in such a way as to circumvent the file-drawer problem, problems of multiple analysis, and the various defects in randomization, statistical application, and documentation pointed out by Hyman. If a variety of parapsychologists and other investigators continue to obtain significant results under these conditions, then the existence of a genuine communications anomaly will have been demonstrated. (pp. 353–354)

We have presented a series of experiments that satisfy these guidelines. Although no single investigator or laboratory can satisfy the requirement of independent replication, the automated ganzfeld studies are quite consistent with the earlier studies. On the basis of the cumulative evidence, we conclude that the ganzfeld effect represents a genuine communications anomaly. This conclusion will either be strengthened or weakened by additional independent replications, but there is no longer any justification for the claim made by some critics that the existing evidence does not warrant serious attention by the scientific community.

Recommendations for Future Research

Recent psi ganzfeld research has necessarily focused on methodological issues arising from the ganzfeld controversy. It is essential that future studies comply with the methodological standards agreed on by researchers and critics. Yet it is equally imperative that serious attention be given to conditions associated with successful outcomes.

Small to medium effect sizes characterize many research findings in the biomedical and social sciences (e.g., Cohen, 1977; Rosenthal, 1984). Rosenthal (1986) and Utts (1986) make a strong case for more careful consideration of the magnitude of effect in the design and analysis of future ganzfeld studies. The automated ganzfeld studies show a success rate slightly in excess of 34%. Utts's (1986) power analysis shows that for an effect of this size, the investigator has only about one chance in three of obtaining a statistically significant result in a 50-trial experiment. Even with 100 trials—an unusually large sample size in ganzfeld research—the probability of a significant outcome is only about .5.

We urge ganzfeld investigators to use dynamic targets and to design their studies to allow subjects to have the option to have friends or acquaintances as their senders. The similarity of the autoganzfeld and meta-analysis data sets strongly indicates that these factors are important moderators of psi ganzfeld performance. If our estimate of the impact of dynamic and static targets is accurate, a 50-session series using dynamic targets has approximately an 84% chance of yielding a significant outcome. A comparable series with static targets has only about one chance in five of achieving significance.

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"FUTURE TELLING": A META-ANALYSIS OF FORCED-CHOICE PRECOGNITION EXPERIMENTS, 1935–1987

BY CHARLES HONORTON AND DIANE C. FERRARI

ABSTRACT: We report a meta-analysis of forced-choice precognition experiments published in the English-language parapsychological literature between 1935 and 1987. These studies involve attempts by subjects to predict the identity of target stimuli selected randomly over intervals ranging from several hundred milliseconds to one year following the subjects' responses. We retrieved 309 studies reported by 62 investigators. Nearly two million individual trials were contributed by more than 50,000 subjects. Study outcomes are assessed by overall level of statistical significance and effect size. There is a small, but reliable overall effect ($z = 11.41$, $p = 6.3 \times 10^{-25}$). Thirty percent of the studies (by 40 investigators) are significant at the 5% significance level. Assessment of vulnerability to selective reporting indicates that a ratio of 46 unreported studies averaging null results would be required for each reported study in order to reduce the overall result to nonsignificance. No systematic relationship was found between study outcomes and eight indices of research quality. Effect size has remained essentially constant over the survey period, whereas research quality has improved substantially. Four moderating variables appear to covary significantly with study outcome: Studies using subjects selected on the basis of prior testing performance show significantly larger effects than studies using unselected subjects. Subjects tested individually by an experimenter show significantly larger effects than those tested in groups. Studies in which subjects are given trial-by-trial or run-score feedback have significantly larger effects than those with delayed or no subject feedback. Studies with brief intervals between subjects' responses and target generation show significantly stronger effects than studies involving longer intervals. The combined impact of these moderating variables appears to be very strong. Independently significant outcomes are observed in seven of the eight studies using selected subjects, who were tested individually and received trial-by-trial feedback.

Precognition refers to the noninferential prediction of future events. Anecdotal claims of "future telling" have occurred throughout human history in virtually every culture and period. Today such

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claims are generally believed to be based on factors such as delusion, irrationality, and superstitious thinking. The concept of precognition runs counter to accepted notions of causality and appears to conflict with current scientific theory. Nevertheless, over the past half-century a substantial number of experiments have been reported claiming empirical support for the hypothesis of precognition. Subjects in forced-choice experiments, according to many reports, have correctly predicted to a statistically significant degree the identity (or order) of target stimuli randomly selected at a later time.

We performed a meta-analysis of forced-choice precognition experiments published in the English-language research literature between 1935 and 1987. Four major questions were addressed through this meta-analysis: (1) Is there overall evidence for accurate target identification (above-chance hitting) in experimental precognition studies? (2) What is the magnitude of the overall precognition effect? (3) Is the observed effect related to variations in methodological quality that could allow a more conventional explanation? (4) Does precognition performance vary systematically with potential moderating variables, such as differences in subject populations, stimulus conditions, experimental setting, knowledge of results, and time interval between subject response and target generation?

Delineating the Domain

Retrieval of Studies

Parapsychological research is still academically taboo, and it is unlikely that there have been many dissertations and theses in this area that have escaped publication. Our retrieval of studies for this meta-analysis is therefore based on the published literature. The studies include all forced-choice precognition experiments appearing in the peer-reviewed English-language parapsychology journals: *Journal of Parapsychology*, *Journal* (and *Proceedings*) *of the Society for Psychical Research*, *Journal of the American Society for Psychical Research*, *European Journal of Parapsychology* (including the *Research Letter* of the Utrecht University Parapsychology Laboratory), and abstracts of peer-reviewed papers presented at Parapsychological Association meetings published in *Research in Parapsychology*.

Criteria for Inclusion

Our review is restricted to fixed-length studies in which significance levels and effect sizes based on direct hitting can be calculated. Studies using outcome variables other than direct hitting, such as run-score variance and displacement effects, are included only if the report provides relevant information on direct hits (i.e., number of trials, hits, and probability of a hit). Finally, we exclude studies conducted by two investigators, S. G. Soal and Walter J. Levy, whose work has been unreliable.

Many published reports contain more than one experiment or experimental unit. In experiments involving multiple conditions, significance levels and effect sizes are calculated for each condition.

Outcome Measures

Significance level. Significance levels (z scores) were calculated for each study from the reported number of trials, hits, and probability of success using the normal approximation to the binomial distribution with continuity correction. Positive z scores indicate above-chance scoring, and negative z scores reflect below-chance scoring.

Effect size. Because most parapsychological experiments, particularly those in the older literature, have used the trial rather than the subject as the sampling unit, we use a trial-based estimator of effect size. The effect size (*ES*) for each study is the z score divided by the square root of the number of trials in the study.[1]

General Characteristics of the Domain

We located 309 studies in 113 separate publications. These studies were contributed by 62 different senior authors and were published over a 53-year period, between 1935 and 1987. Considering the half-century time-span over which the precognition experiments were conducted, it is not surprising that the studies are very diverse.

The database comprises nearly two million individual trials and more than 50,000 subjects. Study sample sizes range from 25 to 297,060 trials (median = 1,194). The number of subjects ranges from 1 to 29,706 (median = 16). The studies use a variety of methodologies, ranging from guessing ESP cards and other card symbols to automated random number generator experiments. The domain encompasses diverse subject populations: the most frequently used

[1] Elsewhere (Honorton, 1985), we have used the effect size index Cohen's h (Cohen, 1977), and one referee has asked that we explain why we are now using $z/N^{1/2}$. The answer is that h and $z/N^{1/2}$ yield virtually identical results, and $z/N^{1/2}$ is computationally simpler. For the present sample of 309 precognition studies, the mean difference between the two indices is .00047, and the standard deviation of the difference is .026: $t(308) = 0.312$, $p = .756$, two-tailed. The correlation between the two indices is .97.

TABLE 1
OVERALL SIGNIFICANCE LEVEL AND EFFECT SIZE

	z	ES
Mean	0.65	0.020
SD	2.68	0.100
Lower 95% confidence estimate	0.40	0.011

Combined $z = 11.41$, $p = 6.3 \times 10^{-25}$

"Fail-safe N" = 14,268

$t(ES) = 3.51$, 308 df, $p = .00025$

population is students (in approximately 40% of the studies); the least frequently used populations are the experimenters themselves and animals (each used in about 5% of the studies).

Though a few studies tested subjects through the mail, more typically subjects were tested in person, either individually or in groups. Target selection methods included no randomization at all (studies using "quasi-random" naturalistic events), informal methods including manual card-shuffling or dice-throwing, and formal methods, primarily random number tables or random number generators. The time interval between the subjects' responses and target generation varied from less than one second to one year.

OVERALL CUMULATION

Evidence for an overall effect is strong. As shown in the top part of Table 1, the overall results are highly significant.[2] Lower bound (one-tailed) 95% confidence estimates of the mean z score and ES are displayed in the bottom portion of Table 1.

Ninety-two studies (30%) show significant hitting at the 5% level, and significant outcomes are contributed by 40 different investigators. The z scores correlate significantly with sample size: $r(307) = .156$, $p = .003$. The mean number of trials for significant studies is [illegible]% larger than the mean number of trials for nonsignificant studies.

[2] The statistical analyses presented here were performed using SYSTAT (Wilkinson, 1988). When t tests are reported on samples with unequal variances, they are calculated using the separate variances within groups for the error and degrees of freedom following Brownlee (1965). Unless otherwise specified, p levels are one-tailed. Combined z's are based on Stouffer's method (Rosenthal, 1984).

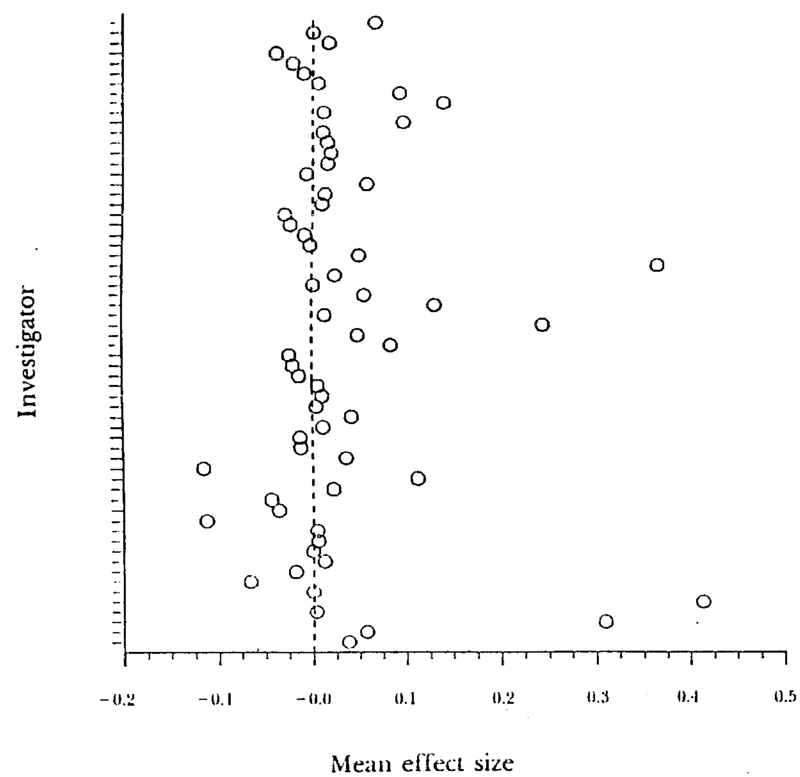


Figure 1. Mean effect size by investigator. N = 62 investigators.

Replication Across Investigators

Virtually the same picture emerges when the cumulation is by investigator rather than study as the unit of analysis; the combined z is 12.13, and 23 of the 62 investigators (37%) have overall outcomes significant at the 5% level. The mean (investigator) effect size is 0.033 ($SD = .093$).

There is a significant difference in the mean ES across investigators, but it is surprisingly small: Kruskal-Wallis one-way ANOVA by ranks, $\chi^2(61) = 82.71$, $p = .034$. The effect is clearly not due to a few major contributors. If investigators contributing more than three studies are eliminated, leaving 33 investigators, the combined z is still 6.00 ($p = 1.25 \times 10^{-9}$) and the mean ES is .028 ($SD = .091$). Figure 1 shows the mean effect sizes by investigator.

These results indicate substantial cross-investigator replicability and directly contradict the claim of critics such as Akers (1987) that successful parapsychological outcomes are achieved by only a few investigators.

The Filedrawer Problem

A well-known reporting bias exists throughout the behavioral sciences favoring publication of "significant" studies (e.g., Sterling, 1959). The extreme view of this "filedrawer problem" is that "the journals are filled with the 5% of the studies that show Type I errors, while the filedrawers back at the lab are filled with the 95% of the studies that show nonsignificance . . ." (Rosenthal, 1984, p. 108). Recognizing the importance of this problem, the Parapsychological Association in 1975 adopted an official policy against selective reporting of positive results.[3] Examination of the parapsychological literature shows that nonsignificant results are frequently published, and in the precognition database, 70% of the studies have reported nonsignificant results. Nevertheless, 75% of the precognition studies were published before 1975, and we must ask to what extent selective publication bias could account for the cumulative effects we observe.

The central section of Table 1 uses Rosenthal's (1984) "fail-safe N" statistic to estimate the number of unreported studies with z scores averaging zero that would be necessary to reduce the known database to nonsignificance. The filedrawer estimate indicates that over 46 unreported studies must exist for each reported study to reduce the cumulative outcome to a nonsignificant level.

A different approach to the filedrawer problem is described by Dawes, Landman, and Williams (1984; personal communication from Dawes to Honorton, July 14, 1988). Their truncated normal curve analysis, like Rosenthal's "fail-safe N," is based on normal curve assumptions. Their null hypothesis is that z scores above some critical level (e.g., $z = 1.65$, 1.96, etc.) are randomly sampled from $N(0, 1)$ above that critical level. The alternative to the null hypothesis is that because there is some real effect, the distribution of z's is shifted to the right of 0 and the z's will be larger than predicted by the null. For a critical level of $z = 1.65$, the expected mean z is 2.06 and the variance is .14. In the precognition database, there are 92 studies with z's > 1.65. Their average is 3.61, not 2.06 as predicted by the null hypothesis. Since the variance of the normal truncated above 1.65 is .14, the *test* z (using the Central Limit Theorem) comparing 3.61 to 2.06 is 39.84 [1.55 divided by $(.14/92)^{1/2}$]. Here, p is virtually zero. Similar results are found with cut points of 1.96, 2.33, and 2.58.

On the basis of these analyses, we conclude that the cumulative significance of the precognition studies cannot satisfactorily be explained by selective reporting.

[3] Analyses indicate no significant difference in the magnitude of reported study outcomes before and after 1975. The mean ES for studies prior to 1975 is 0.021 (SD = .099), and for studies reported thereafter the mean is 0.017 (SD = .106): $t(307) = 0.28$, $p = .782$, two-tailed.

Outlier Reduction

Although the overall z scores and effect sizes cannot reasonably be attributed to chance, inspection of the standard deviations in Table 1 indicates that the study outcomes are extremely heterogeneous. Given the diversity of methods, subject populations, and other study features that characterize this research domain, this is not surprising.

The study outcomes are in fact extremely heterogeneous. Although a major objective of this meta-analysis is to account for the variability across studies by blocking on differences in study quality, procedural features, and sampling characteristics, the database clearly contains extreme outliers. The z scores range from -5.1 to 19.6, a 25-sigma spread! The standardized index of kurtosis (g_2) is 9.47, suggesting that the tails of the distribution are much too long for a normal distribution.

We eliminated the extreme outliers by performing a "10 percent trim" on the study z scores (Barnett & Lewis, 1978). This involves eliminating studies with z scores in the upper and lower 10% of the distribution, and results in an adjusted sample of 248 studies. The trimmed z scores range from -2.24 to 3.21 ($g_2 = -1.1$). The revised z scores and effect sizes are presented in Table 2.

Elimination of extreme outliers reduces the combined z scores by approximately one half, but the outcomes remain highly significant. Twenty-five percent of the studies (62/248) show overall significant hitting at the 5% level. Lower bound confidence estimates show that the mean z's and effect sizes are above 0 at the 95% confidence level.

Elimination of outliers reduces the total number of investigators from 62 to 57, but the results remain basically the same when the analyses are based on investigators rather than studies. The combined z is 6.84; 18 of the 57 investigators (31.6%) have overall sig-

TABLE 2
SIGNIFICANCE LEVEL AND EFFECT SIZE FOR TRIMMED SAMPLE

	z	ES
Mean	0.38	0.012
SD	1.45	0.065
Lower 95% confidence estimate	0.23	0.005

Combined $z = 6.02$, $p = 1.1 \times 10^{-9}$

$t(ES) = 2.90$, 247 df, $p = .002$

nificant outcomes at the 5% level. The mean (investigator) ES is 0.020 ($SD = .05$).

For the trimmed sample, the difference in ES across investigators is *not* significant: Kruskal-Wallis one-way ANOVA by ranks, $\chi^2(56) = 59.34$, $p = .355$. If investigators contributing more than three studies are eliminated, leaving 37 investigators, the combined z is still 5.00 ($p = 3.0 \times 10^{-7}$) and the mean ES is 0.022 ($SD = .056$). Figure 2 shows the mean effect size by investigator.

Thus, elimination of the outliers does not substantially affect the conclusions drawn from our analysis of the database as a whole. There clearly is a nonchance effect. In the remainder of this report, we use the trimmed sample to examine covariations in effect size and a variety of methodological and other study features.

STUDY QUALITY

Because target stimuli in precognition experiments are selected only after the subjects' responses have been registered, precognition studies are usually not vulnerable to sensory leakage problems. Other potential threats to validity must, however, be considered. The problem of variations in research quality remains a source of controversy in meta-analysis. Some meta-analysts advocate eliminating low quality studies whereas others recommend empirically accessing the impact of variations in quality on study outcome. Rosenthal (1984) points out that the practice of discarding studies is equivalent to assigning them weights of zero, and he recommends weighting study z scores in relation to ratings of research quality.

Study Quality Criteria

Ideally, the assessment of study quality should be performed by knowledgeable specialists who are blind to the study outcomes. In

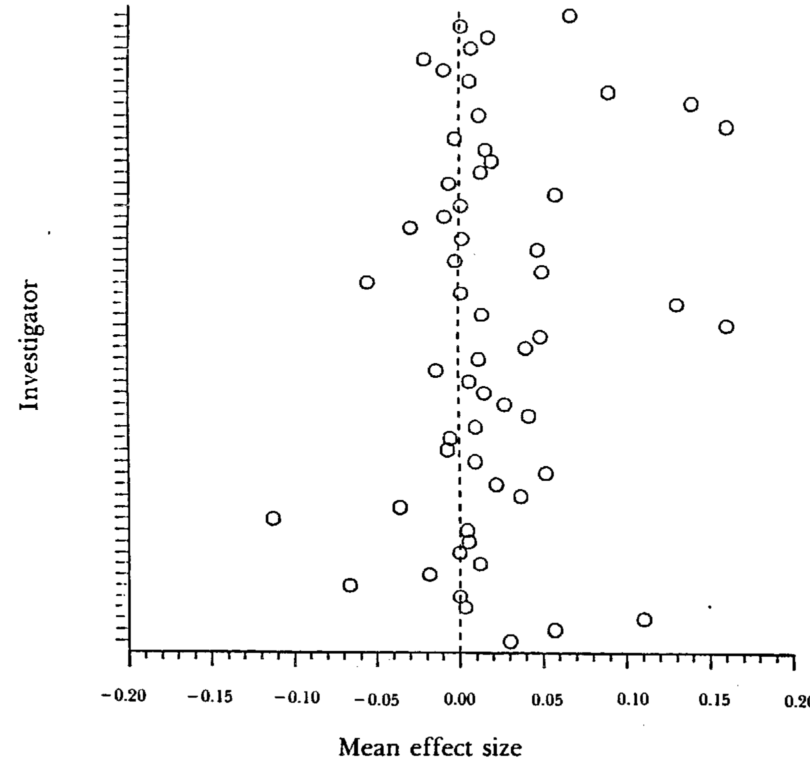


Figure 2. Mean effect size by investigator for trimmed sample. $N = 57$ investigators.

practice, this is usually not feasible, particularly when, as in the present case, large numbers of studies are involved. For our analysis of study quality, statistical and methodological variables are defined and coded in terms of procedural descriptions (or their absence) in the research reports. This approach was used in an earlier meta-analysis of psi ganzfeld research (Honorton, 1985), and it led to study quality ratings that were generally in agreement, $r(26) = .766$, $p = 10^{-6}$, with independent "flaw" ratings by an outside critic (Hyman, 1985).

One point is given (or withheld) for each of the following eight criteria:

Specification of sample size. Does the investigator preplan the number of trials to be included in the study or is the study vulnerable to the possibility of optional stopping? Credit is given to reports that explicitly specify the sample size. Studies involving group testing, in which it is not feasible to specify the sample size precisely, are also given credit. No credit is given to studies in which the sample size is either not preplanned or not addressed in the experimental report.

Preplanned analysis. Is the method of statistical analysis, including the outcome (dependent variable) measure, preplanned? Credit is given to studies explicitly specifying the form of analysis and the outcome measure. No credit is given to those not explicitly stating the form of the analysis or those in which the analysis is clearly post hoc.

Randomization method. Credit is given for use of random number tables, random number generators, and mechanical shufflers. No credit is given for failure to randomize (i.e., use of "quasi-random naturalistic events") or for informal methods such as hand-shuffling, die-casting, and drawing lots.

Controls. Credit is given to studies reporting randomness control checks, such as random number generator (RNG) control series and empirical cross-check controls.

Recording. One point is allotted for automated recording of targets and responses, and another for duplicate recording.

Checking. One point is allotted for automated checking of matches between target and response, and another for duplicate checking of hits.

Study Quality Analysis

Each study received a quality weight between 0 and 8 (mean = 3.3, SD = 1.8). We find no significant relationship between study quality and *ES*: $r(246) = .081$, $p = .202$, two-tailed. This tendency for study outcomes to correlate *positively* with study quality has the consequence that the quality-weighted z score of 6.26 is slightly *larger* than the unweighted z of 6.02. Table 3 shows the correlations between effect size and each of the eight individual quality measures.[1] The mean effect sizes by quality level are displayed graphically in Figure 3.

[1] The correlation between *ES* and study quality is also nonsignificant for the untrimmed sample of 309 studies: $r(307) = -.060$, $p = .289$. The quality-weighted z score is 7.38: $p = 2.32 \times 10^{-13}$. However, three of the individual quality measures are significantly related to performance. Controls and duplicate checking correlate significantly positively with *ES*, and randomization correlates significantly negatively with *ES*. These correlations appear to be due to a few studies with z scores that are extreme outliers ($z > 7$). When the 10 studies with $z > 7$ are eliminated, the significant correlations between quality and *ES* disappear.

TABLE 3

CORRELATIONS BETWEEN EFFECT SIZE AND QUALITY MEASURES

Quality measure	$r(246)$
Sample size specified in advance	−.100
Preplanned analysis	−.001
Randomization	−.011
Controls	.058
Automated recording	.169
Duplicate recording	.047
Automated checking	.136
Duplicate checking	.078

Quality Extremes

Is there a tendency for extremely weak studies to show larger effects than exceptionally "good" studies? Analysis on the extremes of the quality ratings indicates that this is not the case.

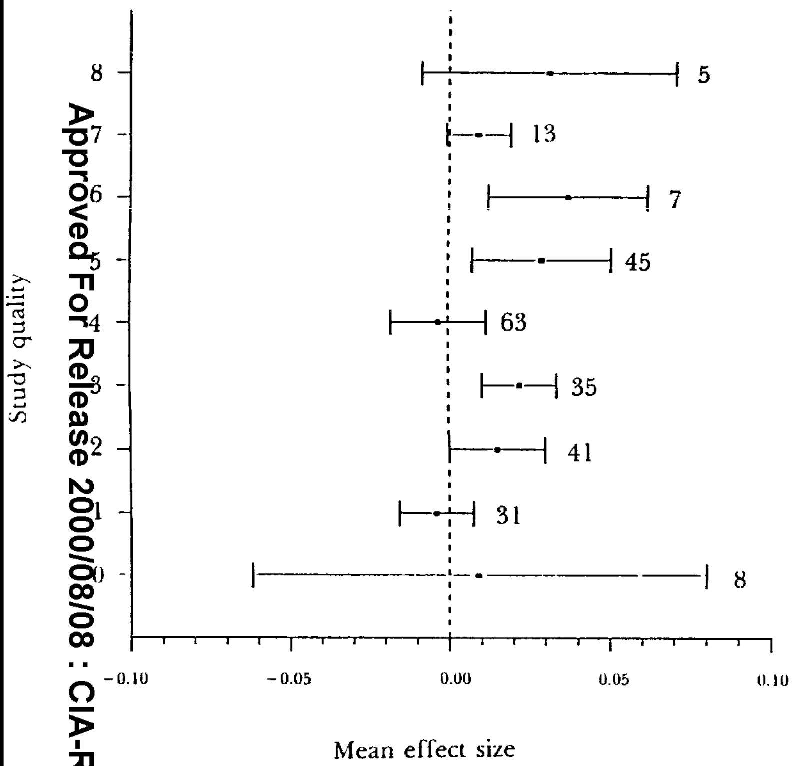
This analysis, based on the untrimmed sample of 309 studies, uses studies with quality ratings outside the interquartile range of the rating distribution (median = 4, $Q_1 = 2$, $Q_3 = 5$). There are 56 "low-quality" studies (ratings of 0–1) and 35 "high-quality" studies (ratings of 6–8). The high-quality studies have effect sizes that are not significantly lower than the low-quality studies; the *ES* means are 0.017 (SD = 0.063) and 0.037 (SD = 0.137), for the low- and high-quality studies, respectively: $t(82) = -.92$, $p = .358$, two-tailed.

Quality Variation in Publication Sources

Precognition *ES* is not significantly related to source of publication: Kruskal-Wallis one-way ANOVA, $\chi^2(4) = 0.78$, $p = .942$. However, the sources of publication differ significantly in study quality: Kruskal-Wallis one-way ANOVA, $\chi^2(4) = 17.19$, $p = .002$. This is due largely to the lower quality of studies published in the *Journal of the Society for Psychical Research* and in *Research in Parapsychology*.

Study Quality in Relation to Year of Publication

Precognition effect size has remained constant over a half-century of research, even though the methodological quality of the re-



ure 3. Precognition effect size in relation to study quality, with 95% conence limits. $N = 248$ studies.

rch has improved significantly during this period. The correlan between *ES* and year of publication is $-.071$: $t(307) = -1.25$, $= .21$, two-tailed. Study quality and year of publication are, howr, positively and significantly correlated: $r(246) = .282$, $p = 2 \times {}^{-7}$, two-tailed.

Critics of parapsychology have long believed that evidence for apsychological effects disappears as the methodological rigor inases. The precognition database does not support this belief.

"Real-Time" Alternatives to Precognition

Investigators have long been aware of the possibility that precogion effects could be modeled without assuming either time reveror backward causality. For example, outcomes from studies with

targets based on indeterminate random number generators (RNGs) could be due to a causal influence on the RNG—a psychokinetic (PK) effect—rather than information acquisition concerning its future state. In experiments with targets based on prepared tables of random numbers, the possibility exists that the experimenter or other randomizer may be the actual psi source, unconsciously using "real-time" ESP combined with PK to choose an entry point in the random number sequence that will significantly match the "subject's" responses. While the latter possibility may seem far-fetched, it cannot be logically eliminated if one accepts the existing evidence for contemporaneous ESP and PK, and it has been argued that it is less far-fetched than the alternative of "true" precognition.

Morris (1982) discusses models of experimental precognition based on "real-time" psi alternatives and methods for testing "true" precognition. In general terms, these methods constrain the selection of the target sequence so as to eliminate nonprecognitive psi intervention. In the most common procedure, attributed to Mangan (1955), dice are thrown to generate a set of numbers that are mathematically manipulated to obtain an entry point in the random number table. This procedure is sufficiently complex "as to be apparently beyond the capacities of the human brain, thus ruling out PK because the 'PKer' would not know what to do even via ESP" (Morris, 1982, p. 329).

Two features of precognition study target determination procedures were coded to assess "real-time" psi alternatives to precognition: method of determining random number table entry point and use of Mangan's method.

Methods of eliminating "real-time" psi alternatives have not been used in studies with random number generators and have only been used in a small number of studies involving randomization by hand-shuffling. These analyses are therefore restricted to studies using random number tables ($N = 138$).

Method of Determining RNT Entry Point

The reports describe six different methods of obtaining entry points in random number tables. If the study outcomes were due to subjects' precognitive functioning rather than to alternative psi modes on the part of the experimenter or the experimenter's assistants, there should be no difference in mean effect size across the various methods used to determine the entry point. Indeed, our analysis indicates that the study effect sizes do not vary systemati-

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cally as a function of method of determining the entry point: Kruskal-Wallis one-way ANOVA by ranks: $\chi^2(5) = 7.32$, $p = .198$.

Use of Mangan's Method

We find no significant difference in *ES* between studies using complex calculations of the type introduced by Mangan to fix the random number table entry point and those that do not use such calculations: $t(45) = 0.38$, $p = .370$, two-tailed.

Moderating Variables

The stability of precognition study outcomes over a 50-year period, which we described earlier, is also bad news. It shows that investigators in this area have yet to develop sufficient understanding of the conditions underlying the occurrence (or detection) of these effects to reliably increase their magnitude. We have identified four variables that appear to covary systematically with precognition *ES*: (1) selected versus unselected subjects, (2) individual versus group testing, (3) feedback level, and (4) time interval between subject response and target generation.

The analyses use the raw study z scores and effect sizes; we found that this results in uniformly more conservative estimates of relationships with moderating variables than when the analyses are based on quality-weighted z scores and effect sizes.

Selected Versus Unselected Subjects

Our meta-analysis identifies eight subject populations: unspecified subject populations, mixtures of several different populations, animals, students, children, "volunteers," experimenter(s), and selected subjects.

Effect size magnitude does not vary significantly across these eight subject populations: Kruskal-Wallis one-way ANOVA, $\chi^2(7) = 10.90$, $p = .143$. Effect sizes by subject population are displayed in Figure 4.

However, studies using subjects selected on the basis of prior performance in experiments or pilot tests show significantly larger effects than studies using unselected subjects. As shown in Table 4, 60% of the studies with selected subjects are significant at the 5% level. The mean z score for these studies is 1.39 ($SD = 1.40$). The *ES* is significantly higher for selected-subjects studies than for studies with unselected subjects. The t test of the difference in mean *ES* is equivalent to a point-biserial correlation of .198.

Does this difference result from less stringent controls in studies with selected subjects? The answer appears to be "No." The average quality of studies with selected subjects is *higher* than studies using

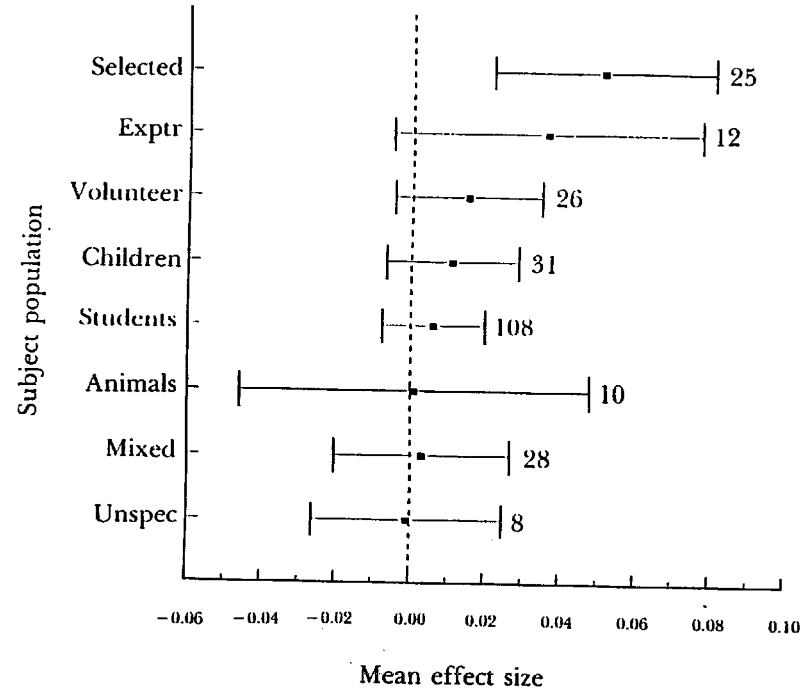

Figure 4. Precognition effect size by subject population, with 95% confidence limits. $N = 248$ studies.

TABLE 4
SELECTED VERSUS UNSELECTED SUBJECTS

	Selected	Unselected
N studies	25	223
Combined z	6.89	4.04
Studies with $p < .05$	60%	21%
Mean ES	.051	.008
SD_{ES}	.075	.063

$t(246) = 3.16$, $p = .001$

TABLE 5
INDIVIDUAL VERSUS GROUP TESTING

	Individual	Group
N studies	97	105
Combined z	6.64	1.29
Studies with $p < .05$	30%	19%
Mean ES	.021	.004
SD_{ES}	.060	.066

$t(200) = 1.89, p = .03$

unselected subjects: $t(27) = 1.51$, $p = .142$, two-tailed. This result appears to reflect a general tendency toward increased rigor and more detailed reporting in studies with selected subjects.

Individual Versus Group Testing

Subjects were tested in groups, individually, or through the mail. Studies in which subjects were tested individually by an experimenter have a significantly larger mean ES than studies involving group testing (Table 5).

The t test of the difference is equivalent to a point-biserial correlation of .132, favoring individual testing. Of the studies with subjects tested individually, 30% are significant at the 5% level.

The methodological quality of studies with subjects tested individually is significantly higher than that of studies involving group testing: $t(137) = 3.08$, $p = .003$, two-tailed. This result is consistent with the conjecture that group experiments are frequently conducted as "targets of opportunity" and may often be carried out hastily in an afternoon without the preparation and planning that go into a study with individual subjects that may be conducted over a period of weeks or months.

Thirty-five studies were conducted through the mail. In these studies, subjects completed the task at their leisure and mailed their responses to the investigator. These correspondence studies yield outcomes similar to those involving individual testing. The combined z score is 2.66, with a mean ES of 0.018 ($SD = .082$). Ten correspondence studies (25.7%) are significant at the 5% level.

Eleven studies are unclassifiable with regard to experimental setting.

TABLE 6
FEEDBACK RECEIVED BY SUBJECTS

	Feedback of Results			
	None	Delayed	Run score	Trial-by-trial
N studies	15	21	21	47
Combined z	−1.30	2.11	4.74	6.98
Studies with $p < .05$	0.0%	19.0%	33.3%	42.6%
Mean ES	−.001	.009	.023	.035
SD_{ES}	.028	.036	.048	.072

Feedback

A significant positive relationship exists between the degree of feedback subjects receive about their performance and precognitive effect size (Table 6).

Subject feedback information is available for 104 studies. These studies fall into four feedback categories: no feedback, delayed feedback (usually notification by mail), run-score feedback, and trial-by-trial feedback. We gave these categories numerical values between 0 and 3. Precognition effect size correlates .231 with feedback level (102 df, $p = .009$). Of the 47 studies involving trial-by-trial feedback, 20 (42.6%) are significant at the 5% level. None of the studies without subject feedback are significant.

Feedback level correlates positively though not significantly with research quality: $r(102) = .173$, $p = .082$, two-tailed. Inadequate randomization is the most plausible source of potential artifacts in studies with trial-by-trial feedback. We performed a separate analysis on the 47 studies in this group. Studies using formal methods of randomization do not differ significantly in mean ES from those with informal randomization: $t(15) = 0.67$, $p = .590$, two-tailed. Similarly, studies reporting randomness control data do not differ significantly in ES from those not including randomness controls: $t(42) = 0.79$, $p = .436$, two-tailed.

Time Interval

The interval between the subject's response and target selection ranges from less than one second to one year. Information about the time interval is available for 144 studies. This information, how-

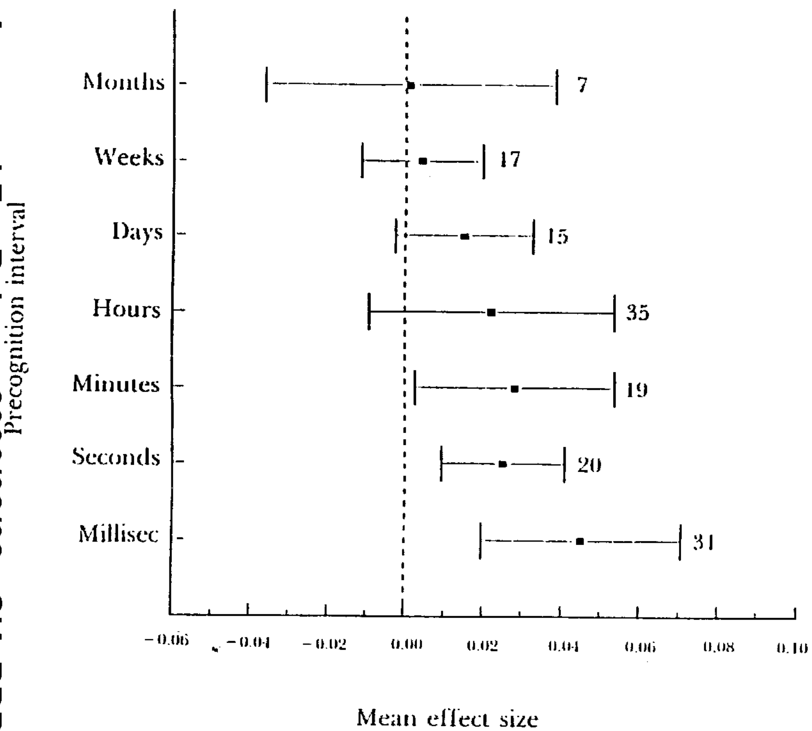

Figure 5. Effect size by precognition interval, with 95% confidence limits. N = 144 studies.

ever, is often imprecise. Our analysis of the relationship between precognitive ES and time interval is therefore limited to seven broad interval categories: milliseconds, seconds, minutes, hours, days, weeks, and months. (Effect sizes by precognition interval are displayed in Figure 5.)

Although it is confounded with degree of feedback, there is a significant decline in precognition ES over increasing temporal distance: $r(142) = -.199$, $p = .017$, two-tailed. The largest effects occur over the millisecond interval: $N = 31$ studies, combined $z = 6.03$, mean $ES = 0.045$, $SD = .073$. The smallest effects occur over periods ranging from a month to a year: $N = 7$, combined $z = 0.53$, mean $ES = 0.001$, $SD = .049$.

Interestingly, the decline of precognition performance over increasing temporal distances results entirely from studies using *un*-

selected subjects: $r(122) = -.235$, $p = .009$, two-tailed. Studies with selected subjects show a nonsignificant positive relationship between ES and time interval: $r(18) = .077$, $p = .745$, two-tailed. Although the difference between these two correlations is not significant ($z = 1.24$), this suggests that the origin of the decline over time may be motivational rather than the result of some intrinsic physical boundary condition. The relationship between precognition ES and feedback also supports this conjecture. Nevertheless, any finding suggesting potential boundary conditions on the phenomenon should be vigorously pursued.

Influence of Moderating Variables in Combination

The above analyses examine the impact of each moderating variable in isolation. In this final set of analyses, we explore their joint influence on precognition performance. For this purpose, we identify two subgroups of studies. One subgroup is characterized by the use of selected subjects tested individually with trial-by-trial feedback. We refer to this as the *Optimal* group ($N = 8$ studies). The second group is characterized by the use of unselected subjects tested in groups with no feedback. We refer to this as the *Suboptimal* group ($N = 9$ studies).

The Optimal studies are contributed by four independent investigators and the Suboptimal studies are contributed by two of the same four investigators. All of the Optimal studies involve short precognition time intervals (millisecond interval); the Suboptimal studies involve longer intervals (intervals of weeks or months). All of the Optimal studies and 5 of the 9 Suboptimal studies use RNG methodology. The two groups do not differ significantly in average sample size. The mean study quality for the Optimal group is significantly higher than that of the Suboptimal studies: Optimal mean = 6.63, $SD = 0.92$; Suboptimal mean = 3.44, $SD = 0.53$; $t(10) = 8.63$, $p = 3.3 \times 10^{-6}$, two-tailed.

The combined impact of the moderating variables appears to be quite strong (Table 7). Seven of the 8 Optimal studies (87.5%) are independently significant at the 5% level, whereas none of the Suboptimal studies are statistically significant. All four investigators contributing studies to the Optimal group have significant outcomes.[5]

[5] In the untrimmed sample of 309 studies, there are a total of 17 Optimal studies. The mean ES is 0.117 ($SD = .154$), and the combined z is 15.84. The percentage of independently significant studies is virtually the same as it is in the trimmed sample: 15 of the 17 studies (88.2%) are significant.

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TABLE 7
IMPACT OF MODERATORS IN COMBINATION

	"Optimal" studies	"Suboptimal" studies
N studies	8	9
Combined z	6.14	−1.29
Studies with $p < .05$	87.5%	0.0%
Mean ES	.055	.005
SD_{ES}	.045	.035

$t(15) = 2.61, p = .01$
$r = .559$

These results are quite striking and suggest that future studies combining these moderators should yield especially reliable effects.

SUMMARY AND CONCLUSIONS

Our meta-analysis of forced-choice precognition experiments confirms the existence of a small but highly significant precognition effect. The effect appears to be replicable; significant outcomes are reported by 40 investigators using a variety of methodological paradigms and subject populations.

The precognition effect is statistically very robust: it remains highly significant despite elimination of studies with z scores in the upper and lower 10% of the z-score distribution and when a third of the remaining investigators—the major contributors of precognition studies—are eliminated.

Estimates of the "filedrawer" problem and consideration of parapsychological publication practices indicate that the precognition effect cannot plausibly be explained on the basis of selective publication bias. Analyses of precognition effect sizes in relation to eight measures of research quality fail to support the hypothesis that the observed effect is driven to any appreciable extent by methodological flaws; indeed, several analyses indicate that methodologically superior studies yield stronger effects than methodologically weaker studies.

Analyses of parapsychological alternatives to precognition, although limited to the subset of studies using random number tables, provide no support for the hypothesis that the effect results from

the operation of contemporaneous ESP and PK at the time of randomization.

Although the overall precognition effect size is small, this does not imply that it has no practical consequences. It is, for example, of the same order of magnitude as effect sizes leading to the early termination of several major medical research studies. In 1981, the National Heart, Lung, and Blood Institute discontinued its study of propranolol because the results were so favorable to the propranolol treatment that it would be unethical to continue placebo treatment (Kolata, 1981); the effect size was 0.04. More recently, The Steering Committee of the Physicians' Health Study Research Group (1988), in a widely publicized report, terminated its study of the effects of aspirin in the prevention of heart attacks for the same reason. The aspirin group suffered significantly fewer heart attacks than a placebo control group; the associated effect size was 0.03.

The most important outcome of the meta-analysis is the identification of several moderating variables that appear to covary systematically with precognition performance. The largest effects are observed in studies using subjects selected on the basis of prior test performance, who are tested individually, and who receive trial-by-trial feedback. The outcomes of studies combining these factors contrast sharply with the null outcomes associated with the combination of group testing, unselected subjects, and no feedback of results. Because the two groups of studies were conducted by a subset of the same investigators, it is unlikely that the observed difference in performance is due to experimenter effects. Indeed, these outcomes underscore the importance of carefully examining differences in subject populations, test setting, and so forth, before resorting to facile "explanations" based on psi-mediated experimenter effects or the "elusiveness of psi."

The identification of these moderating variables has important implications for our understanding of the phenomena and provides a clear direction for future research. The existence of moderating variables indicates that the precognition effect is not merely an unexplained departure from a theoretical chance baseline, but rather is an effect that covaries with factors known to influence more familiar aspects of human performance. It should now be possible to exploit these moderating factors to increase the magnitude and reliability of precognition effects in new studies.

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Paranormal Communication

"Error Some Place!"

by Charles Honorton

Review of the ESP controversy traces debate from statistical and methodological issues to the* a priori *critique and the paradigm of "normal science."

Asked his opinion of ESP, a skeptical psychologist once retorted, "Error Some Place!" I believe he was right, but for the wrong reasons. Western science has always been ambivalent toward the mental side of reality, and it is perhaps not surprising that the occurrence of "psychic" phenomena is one of the most controversial topics in the history of science.

The first serious effort toward scientific examination of psi claims was undertaken by the Society for Psychical Research (SPR), founded in London in 1882 for the purpose of "making an organized and systematic attempt to investigate the large group of phenomena designated by such terms as mesmeric, psychical, and spiritualistic." The SPR leadership included many distinguished scholars of the period, and similar organizations quickly spread to other countries, including the American Society for Psychical Research, founded in New York in 1885 under the aegis of William James, who himself took an active role in early investigations of mediumistic communications.

These turn-of-the-century investigators focused much of their attention on authenticating individual cases of spontaneous experiences suggestive of psi communication. While a great deal of provocative material was carefully examined and reported (e.g., 13), the limitations inherent in the case study approach prohibited definitive conclusions. However thoroughly authenticated, spontaneous cases cannot provide adequate assessment of such potential sources of contamination as chance coincidence, unconscious inference and sensory leakage, retroactive falsification, or deliberate fraud.

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Early experimental approaches primarily involved the "telepathic" reproduction of drawings at a distance (62). While often striking correspondences were obtained, the experimental conditions did not usually provide for random selection of target (stimulus) material, and were not always totally adequate with respect to the possibility of sensory leakage, intentional or otherwise.

Neither the spontaneous case studies nor the early experimental efforts made much impact upon the scientific community, though they drew critical comment from prominent period scientists. "Neither the testimony of all the Fellows of the Royal Society, nor even the evidence of my own senses," proclaimed Helmholtz, "would lead me to believe in the transmission of thought from one person to another independently of the recognized channels of sense." Thomas Huxley declined an invitation to participate in some of the early SPR investigations, saying he would sooner listen to the idle gossip of old women.

The rudiments of an experimental methodology for testing psi were suggested three centuries ago by Francis Bacon.

In *Sylva Sylvarum*, a work published posthumously, Bacon discussed "experiments in consort, monitory, touching transmission of spirits and forces of imagination." He suggested that "the motions of shuffling cards, or casting of dice" could be used to test the "binding of thoughts. . . . The experiment of binding of thoughts should be diversified and tried to the full; and you are to note whether it hit for the most part though not always" (2).

The application of probability theory to the assessment of deviations from theoretically expected chance outcomes was introduced to psychical research in 1884 by the French Nobel laureate, Charles Richet, in experiments involving card-guessing. The popularity of card-guessing as an experimental methodology was greatly influenced by the work of J. B. Rhine and his associates at Duke University in the early 1930s. Rhine (50) devised a standard set of procedures around a simplified card deck containing randomized sequences of five geometric forms (circle, cross, wavy lines, square, and circle). These "ESP cards" were prepared in packs of 25, and each "run" through the pack was associated with a constant binomial probability of 1/5, since subjects were not given trial-by-trial feedback. Providing the experimental conditions were adequate to eliminate illicit sensory cubes, recording errors, and rational inference, statistically significant departures from binomial chance expectation were interpreted as indicating extrasensory communication.

Initially, "telepathy" tests consisted of having a subject in one room attempt to identify the order of the cards as they were observed by an "agent" in another room. In "clairvoyance" tests, the subject attempted to "guess" the order of the cards directly, as they lay concealed in an opaque

Star

scores were in all cases nonsignificant, with a mean scoring rate of 5.04 (43).

Several critics questioned the applicability of the binomial distribution as a basis for assessing the statistical significance of ESP card-guessing data. Willoughby (78) proposed the use of an empirical control series, but later withdrew the suggestion after comparing the two methods (79). Alternative methods of deriving the probable error and recommendations for using the empirical standard deviation were also proposed and later withdrawn (21, 22). Concern over this issue diminished and was generally abandoned following the publication of a large chance control series involving half a million trials and demonstrating close approximation to the binomial model (12).

Another question arose about whether the binomial model provides sufficient approximation to the normal distribution to allow use of normal probability integral tables for determination of significance levels (17). Stuart and Greenwood (73) showed that when the normal distribution is used as an approximation to the binomial model, discrepancies are important only with cases of borderline significance and few trials.

The use of the binomial critical ratio (z) to evaluate the significance of the ESP card-guessing deviations was generally approved by professional statisticians (6, 20). Fisher (10), however, commented that high levels of statistical significance should not be accepted as substitutes for independent replication. In another vein, Huntington (20) asked, "If mathematics has successfully disposed of the hypothesis of chance, what has psychology to say about the hypothesis of ESP?"

The most frequently expressed methodological concern was the possibility of some form of "sensory leakage," giving the ESP subject enough information about the targets to account for significant, extrachance results.

As early as 1895, two Danish psychologists, Hansen and Lehmann (16), reported that with the aid of parabolic reflectors subjects could detect digits and other material silently concentrated upon by an agent. In these experiments, the subject and agent sat with their heads close to the foci of two concave mirrors. While the agent concentrated on the number, he made a special effort to keep his lips closed. Under these conditions, the subjects were frequently successful in identifying the number. These results were interpreted by Hansen and Lehmann as supporting the hypothesis of "involuntary whispering." The utilization of subtle sensory cues was demonstrated in a careful investigation by S. G. Soal of a stage "telepathist" (66). There were also reports, such as the case of "Ilga K.," a mentally retarded Latvian child who could read any text, even in a foreign language, when someone stood behind her, reading "silently." Experiments with dictaphone recordings revealed that "Ilga" was responding to very slight auditory cues (3).

container or in another room, without an agent. "Precognition" tests, introduced somewhat later (59), required the subject to make anticipatory guesses of the card order before the pack was shuffled or otherwise randomized.

Rhine introduced the term "ESP" in his first major report on the Duke University work in 1934 (50). He reported a total of 85,724 card-guessing trials, carried out with a wide variety of subjects and under a wide range of test conditions. The results as a whole were astronomically significant, though informal exploratory trials were indiscriminately pooled with those carried out under more carefully controlled conditions. The best-controlled work during this period was the Pearce-Pratt distance series of clairvoyance tests (58), in which the subject, Pearce, located in one building, attempted to identify the order of the cards as they were handled, but not viewed, by Pratt, the experimenter, located in another building. The level of accuracy obtained in this series of 1,850 trials was associated with a probability of 10^{-22}.

As a stimulant to experimental research, Rhine's work had unprecedented influence. For the first time a common methodology was adopted and employed on a large scale by a number of independent and widely separated investigators. For the first time, also, the scientific community was confronted with a body of data, collected through conventional methods, which it could no longer ignore—nor too hastily accept. The wide-scale adoption of the card-guessing methodology was accompanied by a plethora of critical articles, challenging almost every aspect of the evaluative techniques and the experimental conditions. During the period between 1934 and 1940, approximately 60 critical articles by 40 authors appeared, primarily in the psychological literature. While card-guessing is no longer the primary methodology in experimental parapsychology, the questions which arose over its use are of equal relevance to the more sophisticated approaches used today.

The first major issue concerned the validity of the assumption that the probability of success in the card-guessing experiments was actually 1/5.

If chance expectation is other than 1/5, the significance of the observed deviations would obviously be in doubt. This issue was quickly resolved by mathematical proof and through empirical "cross-checks," a form of control series in which responses (guesses) were deliberately compared with target orders for which they were not intended (e.g., responses on run n_1 matched with the target sequence for run n_2). Empirical cross-checks were reported for 24 separate experimental series involving a total of 12,228 runs (305,700 individual trials). While the actual experimental run scores (e.g., guesses on run n_1 compared to targets for run n_1) were highly significant and yielded a mean scoring rate of 7.23/25, the control cross-check

It is clear that at least some of the early exploratory series reported in Rhine's monograph were open to criticism for inadequate controls against sensory cues. While Rhine did not base major conclusions on such poorly controlled data, inclusion of them in his monograph provided a ready target for critical reviewers and sidetracked discussion away from the better controlled work, such as the Pearce-Pratt series, which was not susceptible to explanation by sensory cues.

Defects in an early commercial printing of ESP cards were reported by several investigators (18, 25). It was found that the cards were warped and could under certain conditions be identified from the back. This discovery circulated widely for a time as an explanation of all successful (i.e., statistically significant) experimental series. The parapsychologists retorted that defective cards had not been employed in any of the experiments reported in the literature and that, in any case, they could not account for results from studies involving adequate screening with such devices as opaque envelopes, screens, distance, or work involving the precognition paradigm in which the target sequences were not generated until after the subject had made his responses (53, 54, 72).

By 1940 nearly one million experimental trials had been reported under conditions which precluded sensory leakage. These included five studies in which the target cards were enclosed in opaque sealed envelopes (41, 45, 46, 54, 59), 16 studies employing opaque screens (7, 8, 11, 19, 33, 34, 35, 38, 41, 42, 44, 45, 46, 59, 71), ten studies involving separation of subjects and targets in different buildings (50, 51, 52, 53, 34, 32, 8, 77, 61, 60), and two studies involving precognition tasks (59, 75). These data are summarized in Table 1. The results were independently significant in 27 of the 33 experiments. By the end of the 1930s there was general agreement that the better-controlled ESP experiments could not be accounted for on the basis of sensory leakage.

The hypothesis that significant "extrachance" deviations in ESP experiments might be attributable to motivated scoring errors was investigated in several studies. In one investigation (26), 28 observers recorded 11,125 mock ESP trials. Of these, 126 (1.13 percent) were misrecorded. Observers favor-

Table 1: ESP card-guessing experiments (1934–1939) excluding sensory cues[a]

Method	Studies	N (Trials)	Mean/25	p<
"Clairvoyance" paradigm, stimuli in sealed, opaque envelopes	5	129,775	5.21	4.0×10^{-11}
"Clairvoyance" paradigm, stimuli concealed by opaque screens	16	497,450	5.44	2.0×10^{-12}
Distance[b]	10	164,475	5.37	10^{-12}
Precognition paradigm[c]	2	115,330	5.15	2.95×10^{-6}

[a] References given in text.
[b] Includes work with both "telepathy" and "clairvoyance" paradigms
[c] Stimuli generated after subjects made their responses

able to the ESP hypothesis made 71.5 percent more errors of commission (increasing ESP scores), while those who were unfavorable to the ESP hypothesis made 100 percent more errors of omission (decreasing ESP scores). Murphy (37) reported an analysis of 175,000 trials from experiments reporting positive evidence for ESP and found only 175 errors (0.10 percent). Greenwood (12) reported only 90 recording errors in rechecking his 500,000-trial control study, of which 76 were errors of omission.

Some critics also alleged that improper selection of data could account for experimental successes. This could be done in several ways: (a) selection of subjects; (b) selection of particular blocks of data out of larger samples; (c) selection of one of several forms of analysis; and (d) selective reporting of particular studies. The questions raised have sometimes been stated cynically in the form, "Parapsychologists must run 100 subjects before they find one with 'ESP'." As if in defense against this charge, a number of the reported studies specifically stated that all of the data collected were included in the analysis (see 43, pp. 118–124, Table 12).

Concerning selection of subjects, Warner (76) suggested two criteria: first, results of "poor" subjects must be included up to the point when they are discontinued since it does not matter how many trials a given *subject* makes as long as all of the *trials* (for all subjects) are included; second, exclude *all* preliminary trials (for both "good" and "poor" subjects) and use preliminary screening studies to select "good" candidates for formal work. These criteria were generally endorsed by the chief critics of the period (e.g., 23).

The question of *post hoc* selection of analyses was not a point of serious concern in the period between 1934 and 1940, though it is relevant to the assessment of some of the process-oriented investigations reported more recently. The question of whether nonsignificant studies were withheld from publication involves an issue which is of great concern to the behavioral sciences as a whole (70, 81) and one which is difficult to accurately assess since there is no way of knowing how many studies may have been withheld from publication because their results failed to disconfirm the null hypothesis.

Several studies of American Psychological Association publication policies (4, 70, 81) indicate that experimental studies in general are more likely to be published if the null hypothesis is rejected at the conventional .05 and .01 alpha levels than if it is not rejected. These studies also indicate that a negligible proportion of published studies are replications. Bozarth and Roberts (4), in a survey of 1,334 articles from psychological journals, found that 94 percent of the articles involving statistical tests of significance reported rejection of specific null hypotheses; only eight articles (less than 1 percent) involved replications of previously published studies.

With respect to the implications of such selection for the ESP hypothesis, there are two partial answers. First, considering the degree of critical interest which prevailed in the 1930s, it seems unlikely that nonsignificant findings would have been repressed during this period; second, the high levels of significance attached to some of the reported ESP investigations would necessitate postulating astronomical numbers of "chance" trials in order to dilute the overall deviations to chance. To take one example, consider the Pearce-Pratt series of 1,850 trials which yielded $p = 10^{-22}$. As Soal and Bateman (66) pointed out, it is difficult to believe that 10^{10} (ten thousand million) sets of 1,850 trials could have possibly been carried out between 1934 and 1940 (or, for that matter, since 1940). But, as Soal and Bateman suggest, ". . . if we posit this absurd estimate as an upper limit [with overall chance totals], that would still give us odds of 10^{10} . . . against the supposition that the Pearce-Pratt results were a run of pure luck."

The possibility of obtaining significant "extrachance" results by stopping an experimental series at "favorable" points was also raised (9, 31). While this "optional stopping" hypothesis was generally agreed to be of significance only in cases of marginally significant results, it led to the adoption of several procedural modifications: specification of the total number of trials in advance of data collection, or accumulation of data in blocks of predetermined size.

The possibility was raised by several critics that hand-shuffled cards may display a tendency to stick together or otherwise produce patterns which could produce spurious results (24, 82). While the cross-check type of control series, described earlier, failed to reveal any evidence of patterning, there was a general trend away from hand shuffling in the later published studies, which utilized tables of prepared random numbers as a basis for generating target sequences.

There was—and is (e.g., 15)—a rather widespread belief that most of the evidence supporting the ESP hypothesis originated in the Duke University studies and that most independent replications by other investigators were nonconfirmatory. A survey of the published literature between 1934 and 1940 fails to support this claim. Table 2 shows all the published experimental reports during this period which provided statistical treatment of the data. Inspection of this table reveals that a majority (61 percent) of the outside replications report significant results ($p < .01$) and that the proportion of significant studies was not significantly greater for the Duke University group ($\chi^2 = 1.70$, 1 *df*).

By 1940, the active methodological controversy was over.

The issues raised were, for the most part, legitimate, and investigators modified their procedures to safeguard their results from methodological criticism. The major issues raised since 1940 center on alleged anomalies in probability theory and the hypothesis of widespread investigator fraud.

Spencer Brown (68, 69) has suggested that statistically significant card-guessing studies provide evidence, not of extrasensory modes of communication, but of fundamental defects in probability theory. He makes three criticisms of random number sequences: (a) published random number

Table 2: Breakdown of experimental ESP studies (1934-1939)

	N (Studies)*	N studies reported significant ($p < .01$)	% signif.
Duke group	17	15	88
Non-Duke	33	20	61
Total	50	35	70

* Includes all English-language studies involving assessment of statistical significance of data, 1934–1939 inclusive.

χ^2 (Duke vs. non-Duke × significant vs. nonsignificant) = 1.70 (1 df)

sequences have been "doctored" prior to publication in order to remove certain nonrandom features; this practice, according to Spencer Brown, makes such sequences nonrandom and invalidates the use of standard significance tests; (b) the source of some random number sequences involves randomizing machines which utilize the unpredictability of human behavior when examined for microscopic variation; such variation, says Spencer Brown, may be predictable enough to account for observed anomalies in random sequences, as well as some of the significant results reported in ESP guessing experiments; (c) Spencer Brown produces evidence to show that anomalous (significant) departures from probability theory can be obtained by matching columns of random numbers (39).

A detailed examination of these points was undertaken by Scott (64). With respect to "doctored" sequences, Scott showed that the maximum error due to rejected (edited) sequences would not affect interpretations of results which are more than marginally significant and could, in fact, increase the likelihood of making a Type II error. On the hypothesis that ESP results are due to some kind of hyper-regularity affecting both the target sequence and the response (guess) sequence simultaneously and similarly, Scott makes the point that this would lead to the expectation of similar results from matching *any* set of humanly produced random sequences. The cross-check type of control series and the Greenwood chance control series described earlier demonstrate that this is not the case. The anomalies reported by Spencer Brown (68), obtained by arbitrarily matching columns of random numbers, have been criticized on the basis of *post hoc* selection (40) and illustrate not that there are fundamental defects in probability theory, but rather that significant deviations from chance can occur in any data where hypotheses and analyses are not specified in advance.

The most recent phase of the ESP controversy centers on the hypothesis of investigator fraud. This argument was most forcefully presented in a lead article in *Science*, entitled "Science and the Supernatural," by G. R. Price (47), who began with the following observations:

> *Believers in psychic phenomena . . . appear to have won a decisive victory and virtually silenced opposition. . . . This victory is the result of an impressive amount of careful experimentation and intelligent argumentation. . . . Against all this evidence, almost the only defense*

remaining to the skeptical scientist is ignorance, ignorance concerning the work itself and concerning its implications. The typical scientist contents himself with retaining . . . some criticism that at most applies to a small fraction of the published studies. But these findings (which challenge our very concepts of space and time) are—if valid—of enormous importance . . . so they ought not to be ignored.

Following Hume's argument on miracles, Price asserted that ESP is "incompatible with current scientific theory," and that it is therefore more parsimonious to believe that parapsychologists cheat than that ESP is a real phenomenon. He concluded, "My opinion concerning the findings of the parapsychologists is that many of them are dependent on clerical and statistical errors and unintentional use of sensory clues, *and that all extra-chance results not so explicable are dependent on deliberate fraud or mildly abnormal mental conditions*" (47, p. 360). This extraordinary critique and the ensuing discussion in *Science* (5, 36, 48, 55, 56, 65) were widely reviewed. As Meehl and Scriven (46) pointed out, Price's argument rests on two highly questionable assumptions, namely that contemporary scientific knowledge is complete, and that ESP necessarily conflicts with it. Seventeen years later, in an "Apology to Rhine and Soal," Price retracted his accusations of investigator fraud (49).

Very similar arguments have, however, been made more recently by the British parapsychological critic C. E. M. Hansel (14, 15), who began his examination of the ESP hypothesis by suggesting that "the *a priori* arguments . . . may even save time and effort in scrutinizing the [ESP] experiments. . . . In view of the *a priori* arguments against it we *know in advance* that telepathy, etc., cannot occur."

Because of the "*a priori* unlikelihood" of ESP, Hansel's examination of the literature centered primarily on the possibility of fraud, by subjects or investigators. He reviewed in depth four experiments which he regarded as providing the best evidence of ESP: the already-mentioned Pearce-Pratt distance series (59); the Pratt-Woodruff (44) series, also conducted at Duke; and Soal's work with Mrs. Stewart and Basil Shackleton (66), as well as a more recent series by Soal and Bowden (67). Hansel showed, in each case, how fraud *could* have been committed (by the experimenters in the Pratt-Woodruff and Soal-Bateman series, and by the subjects in the Pearce-Pratt and Soal-Bowden experiments). He gave no direct evidence that fraud was committed in these experiments but said, "If the result could have arisen through a trick, the experiment must be considered unsatisfactory proof of ESP, *whether or not it is finally decided that such a trick was in fact used*" (15, p. 18, italics mine).

Hansel's argument is unclear, inasmuch as he quite properly insists that no single experiment can be conclusive, then proceeds to show that none is, given the theoretical possibility of fraud by subjects or investigators. Hansel's only conclusion after more than 250 pages of careful scrutiny was that these experiments were not "fraud-proof" and therefore not conclusive proof of ESP.

Two recent examples, one involving cancer research (74) and the other involving parapsychology (57), serve to remind us of the importance of cross-validation in the assessment of *any* experimental finding. In both cases, it should be added, the fraudulent acts were detected in-house, by the researchers themselves. The point is that in the final analysis an experimental finding is of value and is to be taken seriously only to the extent that it leads to further inquiry. To regard any experiment as an end in itself is to remove it from the domain of experimental science. It is obvious that hypothetical construct, such as ESP, cannot be validated by any isolated experiment, no matter how well controlled it might be. Independent replication is a necessary prerequisite.

The claim that psi phenomena operate outside the framework of physical probability has been a major source of a* priori *arguments against acceptance of ESP.

It has been suggested that to accept ESP requires the rejection of physics. This is absurd, and it is worth noting that such arguments have usually been advanced and defended by psychologists rather than by physicists.

The debate over the incompatibility of physics and ESP has been conducted almost exclusively within the framework of nineteenth-century deterministic physics, wherein the ultimate constituent of physical reality was still believed to be solid matter. Inasmuch as modern microphysics has exorcised the material out of matter and deals with processes which on our macrophysical level of sensory perception are every bit as erratic and anomalous as ESP, the *a priori* claim that ESP violates specifiable laws of physics can no longer be considered to be of more than historical interest.

ESP and other psi phenomena, while no longer incompatible with physics, are not yet accounted for by physics; but then, neither are the more familiar processes of memory and conscious experience. Indeed, the transformation of "raw feels" into conscious experience is no less a problem for the neurophysiologists of today than it was for the speculative philosophers of classical antiquity. Sir John Eccles, among others, has repeatedly warned, "We should not pretend that consciousness is not a mystery."

The ESP controversy illustrates several features of the paradigmatic view of science developed by Thomas Kuhn (28). Normal science, according to Kuhn, is essentially a clean-up operation, constrained by a broad theoretical framework, or paradigm, which defines the boundaries of legitimate inquiry. Paradigms are scientific world views which provide coherence and structure and determine the types of questions to be posed of nature, as well as the manner in which answers are sought. Normal science is thus a process of paradigm-articulation, rather than of discovery. Within the paradigm structure of normal science, observations which conflict with the paradigm are seldom made; anomalies are ignored. When the anomalies become sufficiently persistent that they can no longer be ignored, they are hotly disputed. Eventually, a new paradigm is tentatively erected which attracts a group of adherents, and a period of crisis ensues which Kuhn calls a paradigm clash.

In this review I have focused at some length on the period of the 1930s, not because it provides the best available evidence for ESP or the best understanding of the processes underlying its operation—it does neither, but rather because it was during this period that the major *substantive methodological issues* were raised and to a large extent consensually resolved. Since 1940, well over 10,000 journal pages devoted to parapsychological research have been published, and at least 250 experimental studies have been reported. The methodological foundations of the research have gradually diversified, enlarging and enriching the scope of inquiry and providing a basis for more sophisticated study. Automated testing equipment has replaced card-guessing in forced-choice ESP tasks, and quantitative methods have been developed for the objective assessment of psi interactions in nonguessing tasks. Psychophysiological techniques, permitting determination of psi-optimal organismic states, have been introduced and utilized in conjunction with experimental methods more closely approximating the conditions under which psi interactions occur *in vivo*. More important, parapsychological investigators have to a large extent shifted their attention away from the "proof-oriented" approach, which can only reaffirm the presence of anomaly, toward systematic attempts to identify the antecedent conditions necessary for the occurrence and detection of psi interactions, the delineation of positive attributes, and the study of individual differences. Only through the pursuit of such "process-oriented" research can we ever hope to achieve the goals of control, assured replicability (or at least predictability), and eventual understanding.

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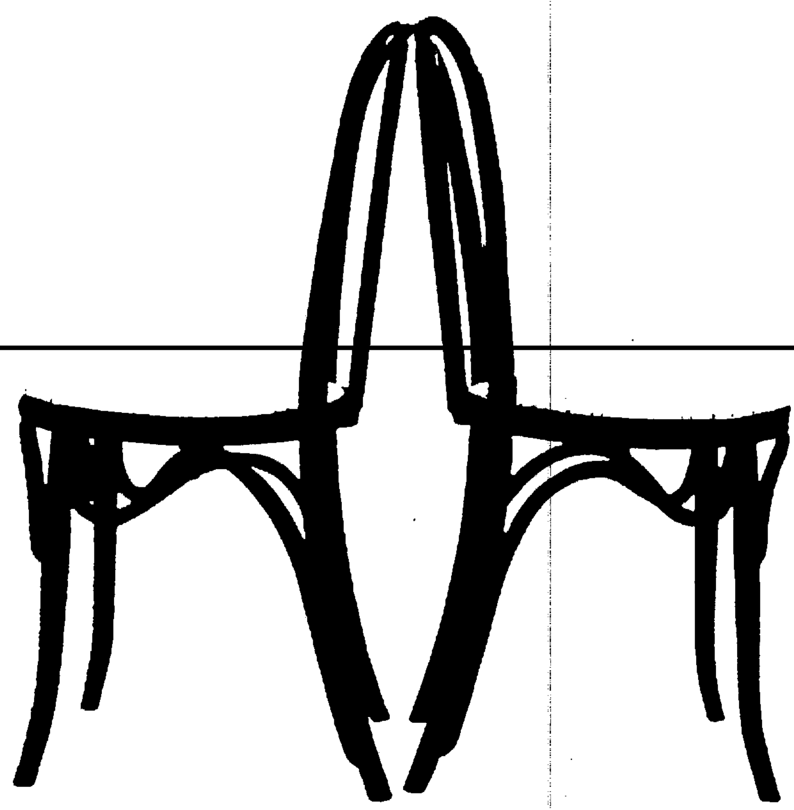

10

A Perceptual Channel for Information Transfer over Kilometer Distances: Historical Perspective and Recent Research

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Abstract—For more than 100 years, scientists have attempted to determine the truth or falsity of claims for the existence of a perceptual channel whereby certain individuals are able to perceive and describe remote data not presented to any known sense. This paper presents an outline of the history of scientific inquiry into such so-called paranormal perception and surveys the current state of the art in parapsychological research in the United States and abroad. The nature of this perceptual channel is examined in a series of experiments carried out in the Electronics and Bioengineering Laboratory of Stanford Research Institute. The perceptual modality most extensively investigated is the ability of both experienced subjects and inexperienced volunteers to view, by innate mental processes, remote geographical or technical targets including buildings, roads, and laboratory apparatus. The accumulated data indicate that the phenomenon is not a sensitive function of distance, and Faraday cage shielding does not in any apparent way degrade the quality and accuracy of perception. On the basis of this research, some areas of physics are suggested from which a description or explanation of the phenomenon could be forthcoming.

I. INTRODUCTION

"IT IS THE PROVINCE of natural science to investigate nature, impartially and without prejudice" [1]. Nowhere in scientific inquiry has this dictum met as great a challenge as in the area of so-called extrasensory perception (ESP), the detection of remote stimuli not mediated by the usual sensory processes. Such phenomena, although under scientific consideration for over a century, have historically been fraught with unreliability and controversy, and validation of the phenomena by accepted scientific methodology has been slow in coming. Even so, a recent survey conducted by the British publication *New Scientist* revealed that 67 percent of nearly 1500 responding readers (the majority of whom are working scientists and technologists) considered ESP to be an established fact or a likely possibility, and 88 percent held the investigation of ESP to be a legitimate scientific undertaking [2].

A review of the literature reveals that although experiments by reputable researchers yielding positive results were begun over a century ago (e.g., Sir William Crookes' study of D. D. Home, 1860's) [3], many consider the study of these phenomena as only recently emerging from the realm of quasi-science. One reason for this is that, despite experimental results, no satisfactory theoretical construct had been advanced to correlate data or to predict new experimental outcomes. Consequently, the area in question remained for a long time in the recipe stage reminiscent of electrodynamics before the unification brought about by the work of Ampere, Faraday, and Maxwell. Since the early work, however, we have seen the development of information theory, quantum theory, and neurophysiological research, and these disciplines provide powerful conceptual tools that appear to bear directly on the issue. In fact, several physicists (Section V) are now of the opinion that these phenomena are not at all inconsistent with the framework of modern physics: the often-held view that observations of this type are *a priori* incompatible with known laws is erroneous in that such a concept is based on the naive realism prevalent before the development of quantum theory. In the emerging view, it is accepted that research in this area can be conducted so as to uncover not just a catalog of interesting events, but rather patterns of cause-effect relationships of the type that lend themselves to analysis and hypothesis in the forms with which we are familiar in the physical sciences. One hypothesis is that information transfer under conditions of sensory shielding is mediated by extremely low-frequency (ELF) electromagnetic waves, a proposal that does not seem to be ruled out by any obvious physical or biological facts. Further, the development of information theory makes it possible to characterize and quantify the performance of a communications channel regardless of the underlying mechanism.

For the past three years, we have had a program in the Electronics and Bioengineering Laboratory of the Stanford Research Institute (SRI) to investigate those facets of human perception that appear to fall outside the range of well-understood perceptual/processing capabilities. Of particular interest is a human information-accessing capability that we call "remote viewing." This phenomenon pertains to the ability of certain individuals to access and describe, by means of mental processes, information sources blocked from ordinary perception, and generally accepted as secure against such access.

In particular, the phenomenon we have investigated most extensively is the ability of a subject to view remote geographical locations up to several thousand kilometers distant from his physical location (given only a known person on whom to target).[1] We have carried out more than fifty experiments under controlled laboratory conditions with several individuals whose remote perceptual abilities have been developed sufficiently to allow them at times to describe correctly—often in great detail—geographical or technical material such as buildings, roads, laboratory apparatus, and the like.

As observed in the laboratory, the basic phenomenon appears to cover a range of subjective experiences variously referred to

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[1] Our initial work in this area was reported in *Nature* [4], and reprinted in the *IEEE Commun. Soc. Newsletter*, vol. 13, Jan. 1975.

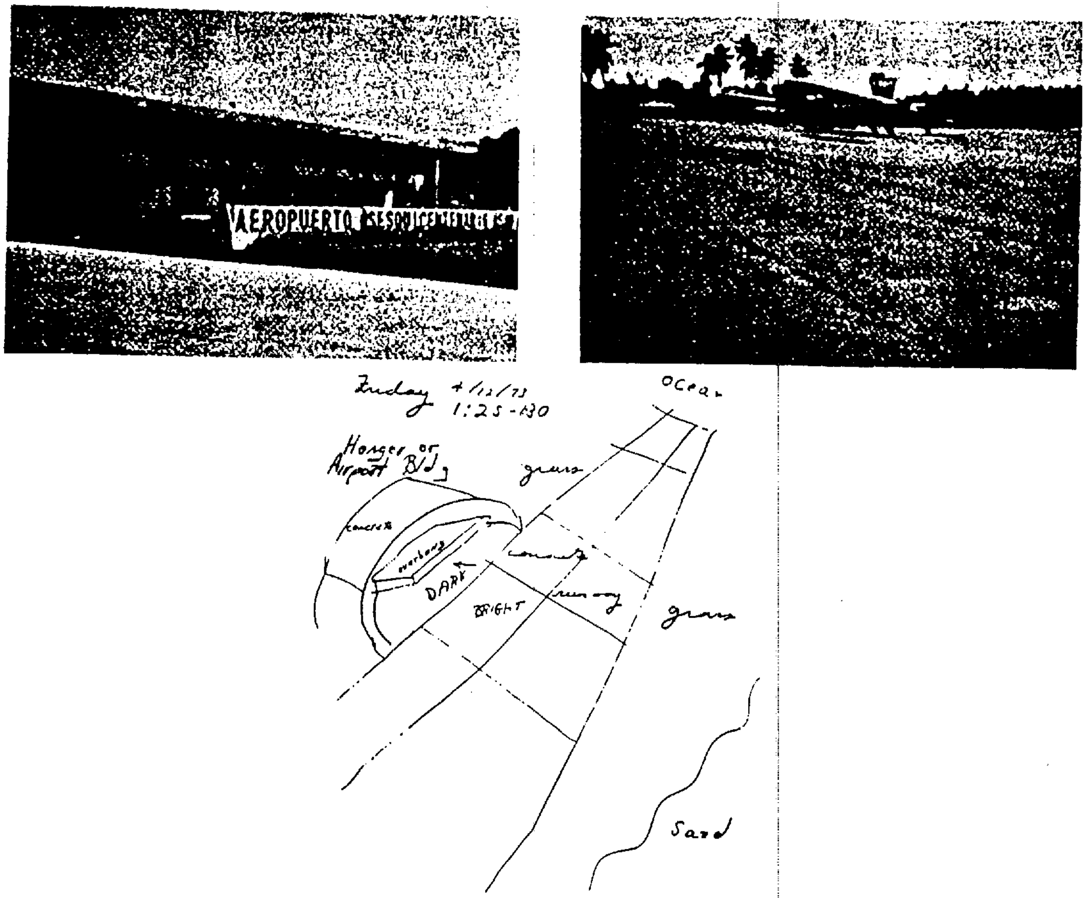


Fig. 1. Airport in San Andres, Colombia, used as remote-viewing target, along with sketch produced by subject in California.

in the literature as autoscopy (in the medical literature); exteriorization or disassociation (psychological literature); simple clairvoyance, traveling clairvoyance, or out-of-body experience (parapsychological literature); or astral projection (occult literature). We choose the term "remote viewing" as a neutral descriptive term free from prior associations and bias as to mechanisms.

The development at SRI of a successful experimental procedure to elicit this capability has evolved to the point where persons such as visiting government scientists and contract monitors, with no previous exposure to such concepts, have learned to perform well; and subjects who have trained over a one-year period have performed excellently under a variety of experimental conditions. Our accumulated data thus indicate that both specially selected and unselected persons can be assisted in developing remote perceptual abilities up to a level of useful information transfer.

In experiments of this type, we have three principal findings. First, we have established that it is possible to obtain significant amounts of accurate descriptive information about remote locations. Second, an increase in the distance from a few meters up to 4000 km separating the subject from the scene to be perceived does not in any apparent way degrade the quality or accuracy of perception. Finally, the use of Faraday cage electrical shielding does not prevent high-quality descriptions from being obtained.

To build a coherent theory for the explanation of these phenomena, it is necessary to have a clear understanding of what constitutes the phenomena. In this paper, we first briefly summarize previous efforts in this field in Section II. We then present in Sections III and IV the results of a series of more than fifty experiments with nine subjects carried out in our own laboratory, which represent a sufficiently stable data base to permit testing of various hypotheses concerning the functioning of this channel. Finally, in Section V, we indicate those areas of physics and information theory that appear to be relevant to an understanding of certain aspects of the phenomena.

First, however, we present an illustrative example generated in an early pilot experiment. As will be clear from our later discussion, this is not a "best-ever" example, but rather a typical sample of the level of proficiency that can be reached and that we have come to expect in our research.

Three subjects participated in a long-distance experiment focusing on a series of targets in Costa Rica. These subjects said they had never been to Costa Rica. In this experiment, one of the experimenters (Dr. Puthoff) spent ten days traveling through Costa Rica on a combination business/pleasure trip. This information was all that was known to the subjects about the traveler's itinerary. The experiment called for Dr. Puthoff to keep a detailed record of his location and activities, including photographs of each of seven target days at 1330 PDT. A total of twelve daily descriptions were collected before the traveler's return: six responses from one subject, five from another, and one from a third.

The third subject who submitted the single response supplied a drawing for a day in the middle of the series. (The subject's response, together with the photographs taken at the site, are shown in Fig. 1). Although Costa Rica is a mountainous country, the subject unexpectedly perceived the traveler at a beach and ocean setting. With some misgiving, he described an airport on a sandy beach and an airstrip with the ocean at the end (correct). An airport building also was drawn, and shown to have a large rectangular overhang (correct). The traveler had taken an unplanned one-day side trip to an offshore island and at the time of the experiment had just disembarked from a plane at a small island airport as described by the subject 4000 km away. The sole discrepancy was that the subject's drawing showed a Quonset-hut type of building in place of the rectangular structure.

The above description was chosen as an example to illustrate a major point observed a number of times throughout the program to be described. Contrary to what may be expected, a subject's description does not necessarily portray what may reasonably be expected to be correct (an educated or "safe" guess), but often runs counter even to the subject's own expectations.

We wish to stress again that a result such as the above is not unusual. The remaining submissions in this experiment provided further examples of excellent correspondences between target and response. (A target period of poolside relaxation was identified; a drive through a tropical forest at the base of a truncated volcano was described as a drive through a jungle below a large bare table mountain; a hotel-room target description, including such details as rug color, was correct; and so on.) So as to determine whether such matches were simply fortuitous—that is, could reasonably be expected on the basis of chance alone—Dr. Puthoff was asked after he had returned to blind match the twelve descriptions to his seven target locations. On the basis of this conservative evaluation procedure, which vastly underestimates the statistical significance of the individual descriptions, five correct matches were obtained. This number of matches is significant at $p = 0.02$ by exact binomial calculation.[2]

The observation of such unexpectedly high-quality descriptions early in our program led to a large-scale study of the phenomenon at SRI under secure double-blind conditions (i.e., target unknown to experimenters as well as subjects), with independent random target selection and blind judging. The results, presented in Sections III and IV, provide strong evidence for the robustness of this phenomenon whereby a human perceptual modality of extreme sensitivity can detect complex remote stimuli.

II. Background

Although we are approaching the study of these phenomena as physicists, it is not yet possible to separate ourselves entirely from the language of the nineteenth century when the laboratory study of the paranormal was begun. Consequently, we continue to use terms such as "paranormal," "telepathy," and the like. However, we intend only to indicate a process of information transfer under conditions generally accepted as secure against such transfer and with no prejudice or occult assumptions as to the mechanisms involved. As in any other scientific pursuit, the purpose is to collect the observables that result from experiments and to try to determine the functional relationships between these observables and the laws of physics as they are currently understood.

Organized research into so-called psychic functioning began roughly in the time of J. J. Thomson, Sir Oliver Lodge, and Sir William Crookes, all of whom took part in the founding of the Society for Psychical Research (SPR) in 1882 in England. Crookes, for example, carried out his principal investigations with D. D. Home, a Scotsman who grew up in America and returned to England in 1855 [3]. According to the notebooks and published reports of Crookes, Home had demonstrated the ability to cause objects to move without touching them. We should note in passing that, Home, unlike most subjects, worked only in the light and spoke out in the strongest possible terms against the darkened seance rooms popular at the time [5].

Sir William Crookes was a pioneer in the study of electrical discharge in gases and in the development of vacuum tubes, some types of which still bear his name. Although everything Crookes said about electron beams and plasmas was accepted, nothing he said about the achievements of D. D. Home ever achieved that status. Many of his colleagues, who had not observed the experiments with Home, stated publicly that they thought Crookes had been deceived, to which Crookes angrily responded:

> Will not my critics give me credit for some amount of common sense? Do they not imagine that the obvious precautions, which occur to them as soon as they sit down to pick holes in my experiments, have occurred to me also in the course of my prolonged and patient investigation? The answer to this, as to all other objections is, prove it to be an error, by showing where the error lies, or if a trick, by showing how the trick is performed. Try the experiment fully and fairly. If then fraud be found, expose it; if it be a truth, proclaim it. This is the only scientific procedure, and it is that I propose steadily to pursue [3].

In the United States, scientific interest in the paranormal was centered in the universities. In 1912, John Coover [6] was established in the endowed Chair of Psychical Research at Stanford University. In the 1920's, Harvard University set up research programs with George Estabrooks and L. T. Troland [7], [8]. It was in this framework that, in 1930, William McDougall invited Dr. J. B. Rhine and Dr. Louisa Rhine to join the Psychology Department at Duke University [9]. For more than 30 years, significant work was carried out at Rhine's Duke University Laboratory. To examine the existence of paranormal perception, he used the now-famous ESP cards containing a boldly printed picture of a star, cross, square, circle, or wavy lines. Subjects were asked to name the order of these cards in a freshly shuffled deck of twenty-five such cards. To test for telepathy, an experimenter would look at the cards one at a time, and a subject suitably separated from the sender would attempt to determine which card was being viewed.

Dr. J. B. Rhine together with Dr. J. G. Pratt carried out thousands of experiments of this type under widely varying conditions [10]. The statistical results from these experiments indicated that some individuals did indeed possess a paranormal perceptual ability in that it was possible to obtain an arbitrarily high degree of improbability by continued testing of a gifted subject.

The work of Rhine has been challenged on many grounds, however, including accusations of improper handling of statistics, error, and fraud. With regard to the statistics, the general consensus of statisticians today is that if fault is to be found in Rhine's work, it would have to be on other than statistical grounds [11]. With regard to the accusations of fraud, the

[2] The probability of a correct daily match by chance for any given transcript is $p = \frac{1}{7}$. Therefore, the probability of at least five correct matches by chance out of twelve tries can be calculated from

$$p = \sum_{i=5}^{12} \frac{12!}{i!\,(12-i)!} \left(\frac{1}{7}\right)^{i} \left(\frac{6}{7}\right)^{(12-i)} = 0.02$$

most celebrated case of criticism of Rhine's work, that of G. R. Price [12], ended 17 years after it began when the accusation of fraud was retracted by its author in an article entitled "Apology to Rhine and Soal," published in the same journal in which it was first put forward [13]. It should also be noted that parapsychological researchers themselves recently exposed fraud in their own laboratory when they encountered it [14].

At the end of the 1940's, Prof. S. G. Soal, an English mathematician working with the SPR, had carried out hundreds of card guessing experiments involving tens of thousands of calls [15]. Many of these experiments were carried out over extended distances. One of the most notable experiments was conducted with Mrs. Gloria Stewart between London and Antwerp. This experiment gave results whose probability of occurring by chance were less than 10^{-8}. With the publication of *Modern Experiments in Telepathy* by Soal and Bateman (both of whom were statisticians), it appeared that card guessing experiments produced significant results, on the average.[3]

The most severe criticism of all this work, a criticism difficult to defend against in principle, is that leveled by the well-known British parapsychological critic C. E. M. Hansel [17], who began his examination of the ESP hypothesis with the stated assumption, "In view of the *a priori* arguments against it *we know in advance* that telepathy, etc., cannot occur." Therefore, based on the "*a priori* unlikelihood" of ESP, Hansel's examination of the literature centered primarily on the possibility of fraud, by subjects or investigators. He reviewed in depth four experiments which he regarded as providing the best evidence of ESP: the Pearce–Pratt distance series [18]; the Pratt–Woodruff [19] series, both conducted at Duke; and Soal's work with Mrs. Stewart and Basil Shackleton [15], as well as a more recent series by Soal and Bowden [20]. Hansel showed, in each case, how fraud *could* have been committed (by the experimenters in the Pratt–Woodruff and Soal–Bateman series, or by the subjects in the Pearce–Pratt and Soal–Bowden experiments). He gave no direct evidence that fraud *was* committed in these experiments, but said, "If the result could have arisen through a trick, the experiment must be considered unsatisfactory proof of ESP, *whether or not it is finally decided that such a trick was in fact used*" [17, p. 18]. As discussed by Honorton in a review of the field [21], Hansel's conclusion after 241 pages of careful scrutiny therefore was that these experiments were not "fraud-proof" and therefore in principle could not serve as conclusive proof of ESP.

Even among the supporters of ESP research and its results, there remained the consistent problem that many successful subjects eventually lost their ability and their scores gradually drifted toward chance results. This decline effect in no way erased their previous astronomical success; but it was a disappointment since if paranormal perception is a natural ability, one would like to see subjects improving with practice rather than getting worse.

One of the first successful attempts to overcome the decline effect was in Czechoslovakia in the work of Dr. Milan Ryzl, a chemist with the Institute of Biology of the Czechoslovakian Academy of Science and also an amateur hypnotist [22]. Through the use of hypnosis, together with feedback and reinforcement, he developed several outstanding subjects, one of whom, Pavel Stepanek, has worked with experimenters around the world for more than 10 years.

Ryzl's pioneering work came as an answer to the questions raised by the 1956 CIBA Foundation conference on extrasensory perception. The CIBA Chemical Company has annual meetings on topics of biological and chemical interest, and that same year they assembled several prominent parapsychologists to have a state-of-the-art conference on ESP [23]. The conference concluded that little progress would be made in parapsychology research until a repeatable experiment could be found; namely, an experiment that different experimenters could repeat at will and that would reliably yield a statistically significant result.

Ryzl had by 1962 accomplished that goal. His primary contribution was a decision to interact with the subject as a person, to try to build up his confidence and ability. His protocol depended on "working with" rather than "running" his subjects. Ryzl's star subject, Pavel Stepanek, has produced highly significant results with many contemporary researchers [24]–[29]. In these experiments, he was able to tell with 60-percent reliability whether a hidden card was green side or white side up, yielding statistics of a million to one with only a thousand trials.

As significant as such results are statistically, the information channel is imperfect, containing noise along with the signal. When considering how best to use such a channel, one is led to the communication theory concept of the introduction of redundancy as a means of coding a message to combat the effects of a noisy channel [30]. A prototype experiment by Ryzl using such techniques has proved to be successful. Ryzl had an assistant select randomly five groups of three digits each. These 15 digits were then encoded into binary form and translated into a sequence of green and white cards in sealed envelopes. By means of repeated calling and an elaborate majority vote protocol, Ryzl was able after 19 350 calls by Stepanek (averaging 9 s per call) to correctly identify all 15 numbers, a result significant at $p = 10^{-15}$ The hit rate for individual calls was 61.9 percent, 11 978 hits, and 7372 misses [31].

Note Added in Proof: It has been brought to our attention that a similar procedure was recently used to transmit without error the word "peace" in International Morse Code (J. C. Carpenter, "Toward the effective utilization of enhanced weak-signal ESP effects," presented at the Annual Meeting of the American Association for the Advancement of Science, New York, NY, Jan. 27, 1975).

The characteristics of such a channel can be specified in accordance with the precepts of communication theory. The bit rate associated with the information channel is calculated from [30]

$$R = H(x) - H_y(x) \tag{1}$$

where $H(x)$ is the uncertainty of the source message containing symbols with *a priori* probability p_i:

$$H(x) = -\sum_{i=1}^{2} p_i \log_2 p_i \tag{2}$$

and $H_y(x)$ is the conditional entropy based on the *a posteriori* probabilities that a received signal was actually transmitted:

$$H_y(x) = -\sum_{i,j}^{2} p(i,j) \log_2 p_i(j). \tag{3}$$

[3]Recently, some of the early Soal experiments have been criticized [16]. However, his long-distance experiments cited here were judged in a double-blind fashion of the type that escaped the criticism of the early experiments.

For Stepanek's run, with $p_i = \frac{1}{2}$, $p_j(j) = 0.619$, and an average time of 9 s per choice, we have a source uncertainty $H(x) = 1$ bit and a calculated bit rate

$$R \approx 0.041 \text{ bit/symbol}$$

or

$$R/T \approx 0.0046 \text{ bit/s}.$$

(Since the 15-digit number (49.8 bits) actually was transmitted at the rate of 2.9×10^{-4} bit/s, an increase in bit rate by a factor of about 20 could be expected on the basis of a coding scheme more optimum than that used in the experiments. See, for example, Appendix A.)

Dr. Charles Tart at the University of California has written extensively on the so-called decline effect. He considers that having subjects attempt to guess cards, or perform any other repetitious task for which they receive no feedback, follows the classical technique for deconditioning any response. He thus considers card guessing "a technique for extinguishing psychic functioning in the laboratory" [32].

Tart's injunctions of the mid-sixties were being heeded at Maimonides Hospital, Brooklyn, NY, by a team of researchers that included Dr. Montague Ullman, who was director of research for the hospital; Dr. Stanley Krippner; and, later, Charles Honorton. These three worked together for several years on experiments on the occurrence of telepathy in dreams. In the course of a half-dozen experimental series, they found in their week-long sessions a number of subjects who had dreams that consistently were highly descriptive of pictorial material that a remote sender was looking at throughout the night. This work is described in detail in the experimenters' book *Dream Telepathy* [33]. Honorton is continuing work of this free-response type in which the subject has no preconceived idea as to what the target may be.

In his more recent work with subjects in the waking state, Honorton is providing homogeneous stimulation to the subject who is to describe color slides viewed by another person in a remote room. In this new work, the subject listens to white noise via earphones and views an homogeneous visual field imposed through the use of Ping-Pong ball halves to cover the subject's eyes in conjunction with diffuse ambient illumination. In this so-called Ganzfeld setting, subjects are again able, now in the waking state, to give correct and often highly accurate descriptions of the material being viewed by the sender [34].

In Honorton's work and elsewhere, it apparently has been the step away from the repetitive forced-choice experiment that has opened the way for a wide variety of ordinary people to demonstrate significant functioning in the laboratory, without being bored into a decline effect.

This survey would be incomplete if we did not indicate certain aspects of the current state of research in the USSR. It is clear from translated documents and other sources [35] that many laboratories in the USSR are engaged in paranormal research.

Since the 1930's, in the laboratory of L. Vasiliev (Leningrad Institute for Brain Research), there has been an interest in the use of telepathy as a method of influencing the behavior of a person at a distance. In Vasiliev's book *Experiments in Mental Suggestion*, he makes it very clear that the bulk of his laboratory's experiments were aimed at long-distance communication combined with a form of behavior modification; for example, putting people at a distance to sleep through hypnosis [36].

Similar behavior modification types of experiments have been carried out in recent times by I. M. Kogan, Chairman of the Bioinformation Section of the Moscow Board of the Popov Society. He is a Soviet engineer who, until 1969, published extensively on the theory of telepathic communication [37]-[40]. He was concerned with three principal kinds of experiments: mental suggestion without hypnosis over short distances, in which the percipient attempts to identify an object; mental awakening over short distances, in which a subject is awakened from a hypnotic sleep at the "beamed" suggestion from the hypnotist; and long-range (intercity) telepathic communication. Kogan's main interest has been to quantify the channel capacity of the paranormal channel. He finds that the bit rate decreases from 0.1 bit/s for laboratory experiments to 0.005 bit/s for his 1000-km intercity experiments.

In the USSR, serious consideration is given to the hypothesis that telepathy is mediated by extremely low-frequency (ELF) electromagnetic propagation. (The pros and cons of this hypothesis are discussed in Section V of this paper.) In general, the entire field of paranormal research in the USSR is part of a larger one concerned with the interaction between electromagnetic fields and living organisms [41], [42]. At the First International Congress on Parapsychology and Psychotronics in Prague, Czechoslovakia, in 1973, for example, Kholodov spoke at length about the susceptibility of living systems to extremely low-level ac and dc fields. He described conditioning effects on the behavior of fish resulting from the application of 10 to 100 μW of RF to their tank [43]. The USSR take these data seriously in that the Soviet safety requirements for steady-state microwave exposure set limits at 10 $\mu W/cm^2$, whereas the United States has set a steady-state limit of 10 mW/cm^2 [44]. Kholodov spoke also about the nonthermal effects of microwaves on animals' central nervous systems. His experiments were very carefully carried out and are characteristic of a new dimension in paranormal research.

The increasing importance of this area in Soviet research was indicated recently when the Soviet Psychological Association issued an unprecedented position paper calling on the Soviet Academy of Sciences to step up efforts in this area [45]. They recommended that the newly formed Psychological Institute within the Soviet Academy of Sciences and the Psychological Institute of the Academy of Pedagogical Sciences review the area and consider the creation of a new laboratory within one of the institutes to study persons with unusual abilities. They also recommended a comprehensive evaluation of experiments and theory by the Academy of Sciences' Institute of Biophysics and Institute for the Problems of Information Transmission.

The Soviet research, along with other behavioristically oriented work, suggests that in addition to obtaining overt responses such as verbalizations or key presses from a subject, it should be possible to obtain objective evidence of information transfer by direct measurement of physiological parameters of a subject. Kamiya, Lindsley, Pribram, Silverman, Walter, and others brought together to discuss physiological methods to detect ESP functioning, have suggested that a whole range of electroencephalogram (EEG) responses such as evoked potentials (EP's), spontaneous EEG, and the contingent negative variation (CNV) might be sensitive indicators of the detection of remote stimuli not mediated by usual sensory processes [46].

Early experimentation of this type was carried out by Douglas Dean at the Newark College of Engineering. In his search for physiological correlates of information transfer, he used the plethysmograph to measure changes in the blood volume in a finger, a sensitive indicator of autonomic nervous system functioning [47]. A plethysmographic measurement was made on the finger of a subject during telepathy experiments. A sender looked at randomly selected target cards consisting of names known to the subject, together with names unknown to him (selected at random from a telephone book). The names of the known people were contributed by the subject and were to be of emotional significance to him. Dean found significant changes in the chart recording of finger blood volume when the remote sender was looking at those names known to the subject as compared with those names randomly chosen.

Three other experiments using the physiological approach have now been published. The first work by Tart [48], a later work by Lloyd [49], and most recently the work by the authors [4] all follow a similar procedure. Basically, a subject is closeted in an electrically shielded room while his EEG is recorded. Meanwhile, in another laboratory, a second person is stimulated from time to time, and the time of that stimulus is marked on the magnetic-tape recording of the subject's EEG. The subject does not know when the remote stimulus periods are as compared with the nonstimulus periods.

With regard to choice of stimulus for our own experimentation, we noted that in previous work others had attempted, without success, to detect evoked potential changes in a subject's EEG in response to a single stroboscopic flash stimulus observed by another subject [50]. In a discussion of that experiment, Kamiya suggested that because of the unknown temporal characteristics of the information channel, it might be more appropriate to use repetitive bursts of light to increase the probability of detecting information transfer [51]. Therefore, in our study we chose to use a stroboscopic flash train of 10-s duration as the remote stimulus.

In the design of the study, we assumed that the application of the remote stimulus would result in responses similar to those obtained under conditions of direct stimulation. For example, when an individual is stimulated with a low-frequency (< 30 Hz) flashing light, the 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 [52]. We hypothesized that if we stimulated one subject in this manner (a putative sender), the EEG of another subject in a remote room with no flash present (a receiver) might show changes in alpha (9–11 Hz) activity and possibly an EEG driving similar to that of the sender, or other coupling to the sender's EEG [53]. The receiver was seated in a visually opaque, acoustically and electrically shielded, double-walled steel room about 7 m from the sender. The details of the experiment, consisting of seven runs of thirty-six 10-s trials each (twelve periods each for 0-Hz, 6-Hz, and 16-Hz stimuli, randomly intermixed), are presented in [4]. This experiment proved to be successful. The receiver's alpha activity (9–11 Hz) showed a significant reduction in average power (−24 percent, $p < 0.04$) and peak power (−28 percent, $p < 0.03$) during 16-Hz flash stimuli as compared with periods of no-flash stimulus. [A similar response was observed for 6-Hz stimuli (−12 percent in average power, −21 percent in peak power), but the latter result did not reach statistical significance.] Fig. 2 shows an overlay of three averaged EEG spectra from one of the subject's 36 trial runs, displaying differences in alpha activity during the three stimulus conditions. Extensive control procedures were undertaken to determine if these

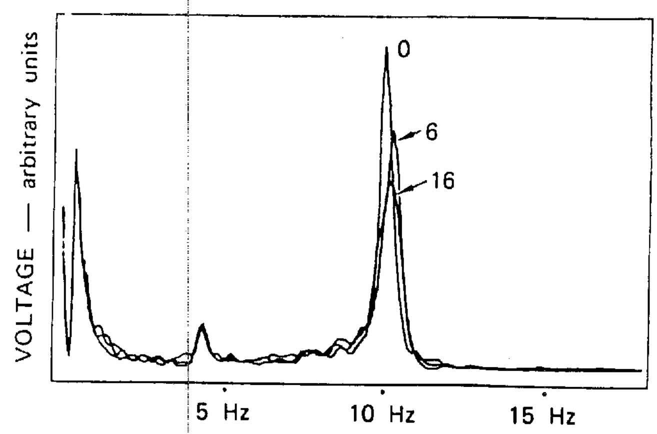


Fig. 2. Occipital EEG frequency spectra, 0–20 Hz, of one subject (H.H acting as receiver showing amplitude changes in the 9–11-Hz band as function of strobe frequency. Three cases: 0-, 6-, and 16-Hz flash (twelve trial averages).

results were produced by system artifacts, electromagneti pickup (EMI), or subtle cueing; the results were negative [4]

As part of the experimental protocol, the subject was aske to indicate a conscious assessment for each trial (via telegrap key) as to the nature of the stimulus; analysis showed thes guesses to be at chance. Thus arousal as evidenced by signifi cant alpha blocking occurred only at the noncognitive level o physiological response. Hence the experiment provided direc physiological (EEG) evidence of perception of remote stimul even in the absence of overt cognitive response.

Whereas in our experiments we used a remote light flash as stimulus, Tart [48] in his work used an electrical shock t himself as sender, and Lloyd [49] simply told the sender t think of a red triangle each time a red warning light wa illuminated within his view. Lloyd observed a consisten evoked potential in his subjects; whereas in our experiment and in Tart's, a reduction in amplitude and a desynchroniza tion of alpha was observed—an arousal response. (If a subjec is resting in an alpha-dominant condition and he is ther stimulated, for example in any direct manner, one will observ a desynchronization and decrease in alpha power.) We con sider that these combined results are evidence for the existenc of noncognitive awareness of remote happenings and that the have a profound implication for paranormal research.

III. SRI Investigations of Remote Viewing

Experimentation in remote viewing began during studies carried out to investigate the abilities of a New York artist, Ingo Swann, when he expressed the opinion that the insights gained during experiments at SRI had strengthened his ability (verified in other research before he joined the SRI program) to view remote locations [54]. To test Mr. Swann's assertion, a pilot study was set up in which a series of targets from around the globe were supplied by SRI personnel to the experimenters on a double-blind basis. Mr. Swann's apparent ability to describe correctly details of buildings, roads, bridges, and the like indicated that it may be possible for a subject by means of mental imagery to access and describe randomly chosen geographical sites located several miles from the subject's position and demarcated by some appropriate means. Therefore, we set up a research program to test the remote-viewing hypothesis under rigidly controlled scientific conditions.

In carrying out this program, we concentrated on what we considered to be our principal responsibility—to resolve under unambiguous conditions the basic issue of whether or not this class of paranormal perception phenomenon exists. At all times, we and others responsible for the overall program took measures to prevent sensory leakage and subliminal cueing and to prevent deception, whether intentional or unintentional. To ensure evaluations independent of belief structures of both experimenters and judges, all experiments were carried out under a protocol, described below, in which target selection at the beginning of experiments and blind judging of results at the end of experiments were handled independently of the researchers engaged in carrying out the experiments.

Six subjects, designated S1 through S6, were chosen for the study. Three were considered as gifted or experienced subjects (S1 through S3), and three were considered as learners (S4 through S6). The *a priori* dichotomy between gifted and learners was based on the experienced group having been successful in other studies conducted before this program and the learners group being inexperienced with regard to paranormal experimentation.

The study consisted of a series of double-blind tests with local targets in the San Francisco Bay Area so that several independent judges could visit the sites to establish documentation. The protocol was to closet the subject with an experimenter at SRI and at an agreed-on time to obtain from the subject a description of an undisclosed remote site being visited by a target team. In each of the experiments, one of the six program subjects served as remote-viewing subject, and SRI experimenters served as a target demarcation team at the remote location chosen in a double-blind protocol as follows.

In each experiment, SRI management randomly chose a target location from a list of targets within a 30-min driving time from SRI; the target location selected was kept blind to subject and experimenters. The target pool consisted of more than 100 target locations chosen from a target-rich environment. (Before the experimental series began, the Director of the Information Science and Engineering Division, not otherwise associated with the experiment, established the set of locations as the target pool which remained known only to him. The target locations were printed on cards sealed in envelopes and kept in the SRI Division office safe. They were available only with the personal assistance of the Division Director who issued a single random-number selected target card that constituted the traveling orders for that experiment.)

In detail: To begin the experiment, the subject was closeted with an experimenter at SRI to wait 30 min before beginning a narrative description of the remote location. A second experimenter then obtained from the Division Director a target location from a set of traveling orders previously prepared and randomized by the Director and kept under his control. The target demarcation team, consisting of two to four SRI experimenters, then proceeded by automobile directly to the target without any communication with the subject or experimenter remaining behind. The experimenter remaining with the subject at SRI was kept ignorant of both the particular target and the target pool so as to eliminate the possibility of cueing (overt or subliminal) and to allow him freedom in questioning the subject to clarify his descriptions. The demarcation team remained at the target site for an agreed-on 15-min period following the 30 min allotted for travel.[4] During the observation period, the remote-viewing subject was asked to describe his impressions of the target site into a tape recorder and to make any drawings he thought appropriate. An informal comparison was then made when the demarcation team returned, and the subject was taken to the site to provide feedback.

A. Subject S1: Experienced

To begin the series, Pat Price, a former California police commissioner and city councilman, participated as a subject in nine experiments. In general, Price's ability to describe correctly buildings, docks, roads, gardens, and the like, including structural materials, color, ambience, and activity—often in great detail—indicated the functioning of a remote perceptual ability. A Hoover Tower target, for example, was recognized and named by name. Nonetheless, in general, the descriptions contained inaccuracies as well as correct statements. A typical example is indicated by the subject's drawing shown in Fig. 3 in which he correctly described a park-like area containing two pools of water: one rectangular, 60 by 89 ft (actual dimensions 75 by 100 ft); the other circular, diameter 120 ft (actual diameter 110 ft). He incorrectly indicated the function, however, as water filtration rather than recreational swimming. (We often observe essentially correct descriptions of basic elements and patterns coupled with incomplete or erroneous analysis of function.) As can be seen from his drawing, he also included some elements, such as the tanks shown in the upper right, that are not present at the target site. We also note an apparent left–right reversal, often observed in paranormal perception experiments.

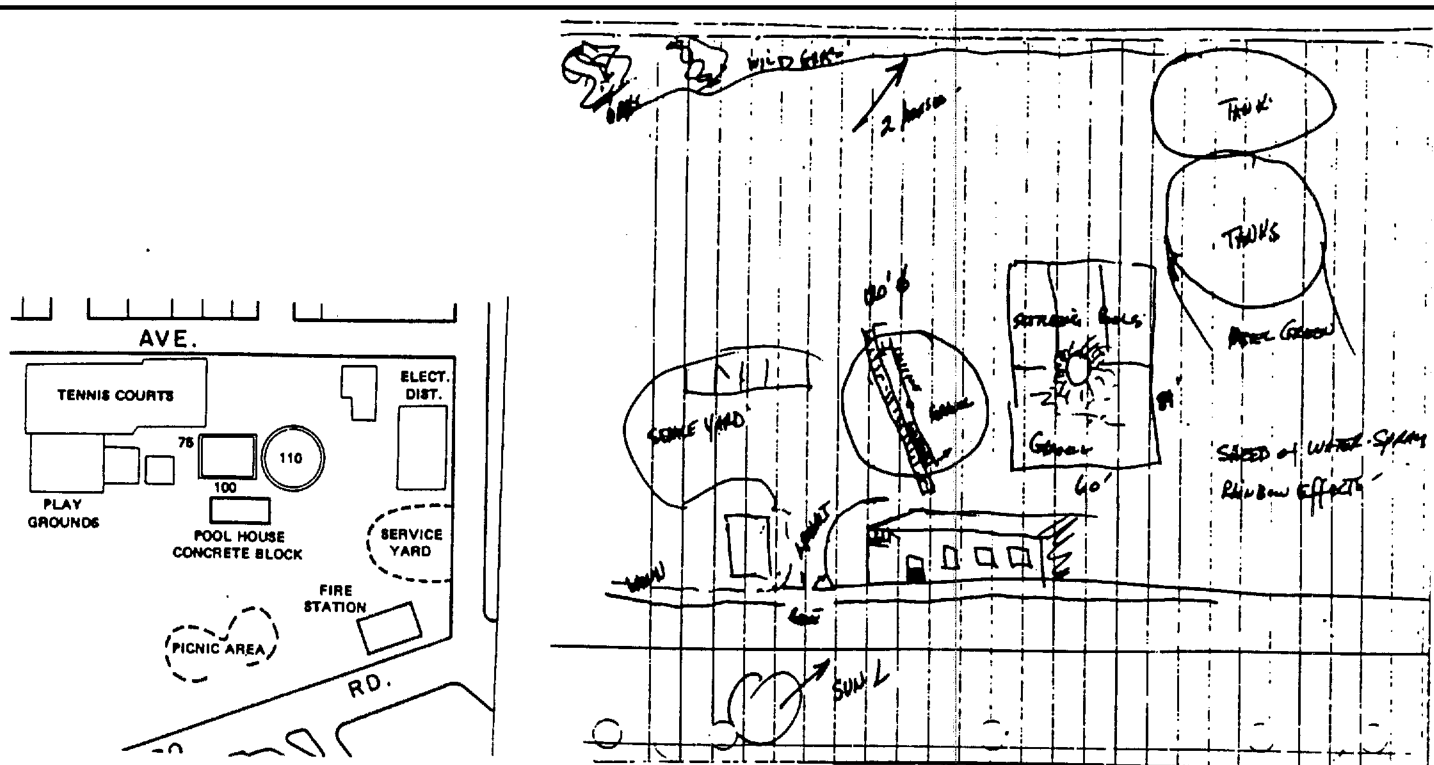
To obtain a numerical evaluation of the accuracy of the remote-viewing experiment, the experimental results were subjected to independent judging on a blind basis by an SRI research analyst not otherwise associated with the research. The subject's response packets, which contained the nine typed unedited transcripts of the tape-recorded narratives along with any associated drawings, were unlabeled and presented in random order. While standing at each target location, visited in turn, the judge was required to blind rank order the nine packets on a scale 1 to 9 (best to worst match). The statistic of interest is the sum of ranks assigned to the target-associated transcripts, lower values indicating better matches. For nine targets, the sum of ranks could range from nine to eighty-one. The probability that a given sum of ranks s or less will occur by chance is given by [55]

$$\Pr(s \text{ or less}) = \frac{1}{N^n} \sum_{i=n}^{s} \sum_{l=0}^{k} (-1)^l \binom{n}{l} \binom{i - Nl - 1}{n - 1}$$

where s is obtained sum of ranks, N is number of assignable ranks, n is number of occasions on which rankings were made, and l takes on values from zero to the least positive integer k in $(i - n)/n$. (Table I is a table to enable easy application of the above formula to those cases in which $N = n$.) The sum in this case, which included seven direct hits out of the nine, was 16 (see Table II), a result significant at $p = 2.9 \times 10^{-5}$ by exact calculation.

In Experiments 3, 4, and 6 through 9, the subject was secured in a double-walled copper-screen Faraday cage. The Faraday cage provides 120-dB attenuation for plane-wave radio-frequency radiation over a range of 15 kHz to 1 GHz. For magnetic fields, the attenuation is 68 dB at 15 kHz and decreases to 3 dB at 60 Hz. The results of rank order judging (Table II) indicate that the use of Faraday cage electrical

[4] The first subject (S1) was allowed 30 min for his descriptions, but it was found that he fatigued and had little comment after the first 15 min. The viewing time was therefore reduced to 15 min for subjects S2 through S6.



(a) (b)

Fig. 3. Swimming pool complex as remote-viewing target. (a) City map of target location. (b) Drawing by Price (S1).

TABLE I
CRITICAL VALUES OF SUMS OF RANKS FOR PREFERENTIAL MATCHING

Number of Assignable Ranks (N)	Probability (one-tailed) that the Indicated Sum of Ranks or Less Would Occur by Chance													
	0.20	0.10	0.05	0.04	0.025	0.01	0.005	0.002	0.001	0.0005	10^{-4}	10^{-5}	10^{-6}	10^{-7}
4	7	6	5	5	5	4	4							
5	11	10	9	8	8	7	6	6	5	5				
6	16	15	13	13	12	11	10	9	8	7	6			
7	22	20	18	18	17	15	14	12	12	11	9	8		
8	29	27	24	24	22	20	19	17	16	15	13	11	9	8
9	37	34	31	30	29	26	24	22	21	20	17	14	12	10
10	46	42	39	38	36	33	31	29	27	25	22	19	16	13
11	56	51	48	47	45	41	38	36	34	32	28	24	20	17
12	67	61	58	56	54	49	47	43	41	39	35	30	25	22

Note: This table applies only to those special cases in which the number of occasions on which objects are being ranked (n) is equal to the number of assignable ranks (N). Each entry represents the largest number that is significant at the indicated p-level. *Source:* R. L. Morris [55].

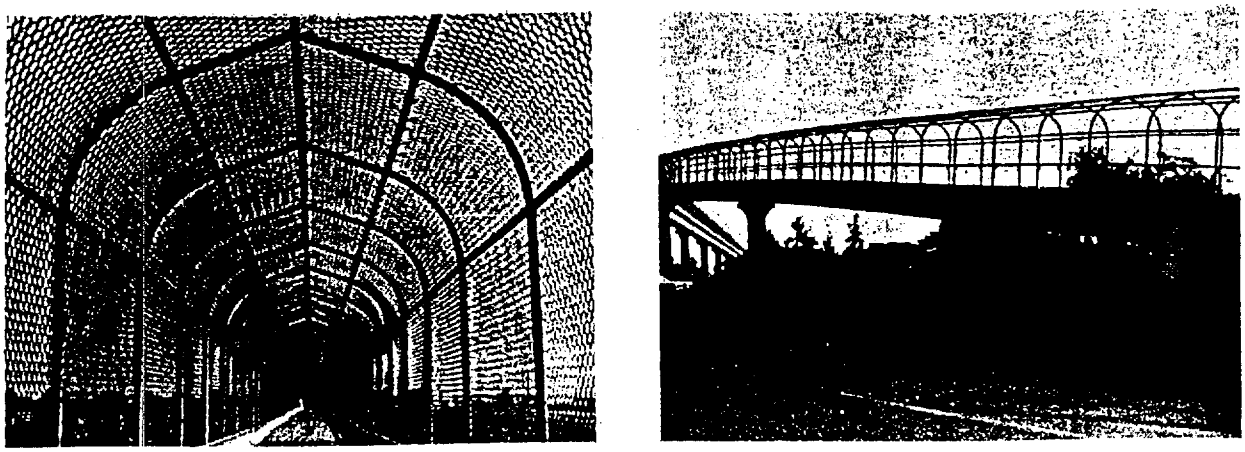
shielding does not prevent high-quality descriptions from being obtained.

As a backup judging procedure, a panel of five additional SRI scientists not otherwise associated with the research were asked simply to blind match the unedited typed transcripts (with associated drawings) generated by the remote viewer against the nine target locations which they independently visited in turn. The transcripts were unlabeled and presented in random order. A correct match consisted of a transcript of a given date being matched to the target of that date. Instead of the expected number of 1 match each per judge, the number of correct matches obtained by the five judges was 7, 6, 5, 3, and 3, respectively. Thus, rather than the expected total number of 5 correct matches from the judges, 24 such matches were obtained.

B. Subject S4: Learner

This experiment was designed to be a replication of our previous experiment with Price, the first replication attempted. The subject for this experiment was Mrs. Hella Hammid, a gifted professional photographer. She was selected for this series on the basis of her successful performance as a percipient in the EEG experiment described earlier. Outside of that interaction, she had no previous experience with apparent paranormal functioning.

At the time we began working with Mrs. Hammid, she had no strong feelings about the likelihood of her ability to succeed in this task. This was in contrast to both Ingo Swann who had come to our laboratory fresh from a lengthy and apparently successful series of experiments with Dr. Gertrude Schmeidler at City College of New York [56] and Pat Price



PEDESTRIAN OVERPASS TARGET

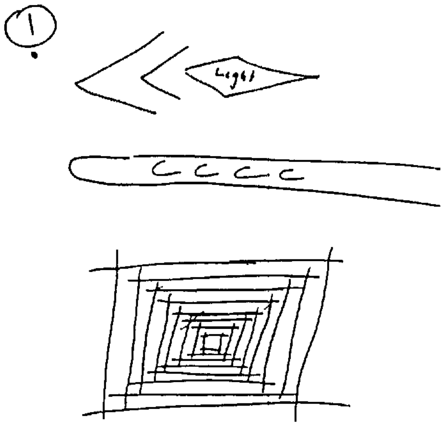


Fig. 4. Subject Hammid (S4) drawing, described as "some kind of diagonal trough up in the air."

TABLE II
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR EXPERIENCED SUBJECT PRICE (S1)

Target Location	Distance (km)	Rank of Associated Transcript
Hoover Tower, Stanford	3.4	1
Baylands Nature Preserve, Palo Alto	6.4	1
Radio telescope, Portola Valley	6.4	1
Marina, Redwood City	6.8	1
Bridge toll plaza, Fremont	14.5	6
Drive-in theater, Palo Alto	5.1	1
Arts and Crafts Plaza, Menlo Park	1.9	1
Catholic Church, Portola Valley	8.5	3
Swimming pool complex, Palo Alto	3.4	1
Total sum of ranks		16 ($p=2.9\times10^{-5}$)

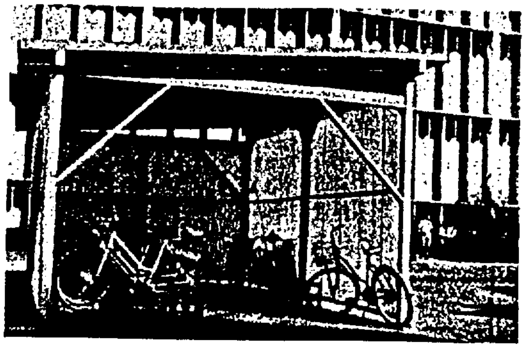
who felt that he used his remote-viewing ability in his everyday life.

In comparison with the latter two, many people are more influenced by their environment and are reluctant under public scrutiny to attempt activities that are generally thought to be impossible. Society often provides inhibition and negative feedback to the individual who might otherwise have explored his own nonregular perceptual ability. We all share an historical tradition of "the stoning of prophets and the burning of witches," and in more modern times the ostracization of those who claim to perceive things that the majority do not admit to seeing. Therefore, in addition to maintaining scientific rigor, one of our primary tasks as researchers is to provide an environment in which the subject feels safe to explore the possibility of paranormal perception. With a new subject, we also try to stress the nonuniqueness of the ability because from our experience paranormal functioning appears to be a latent ability that all subjects can articulate to some degree.

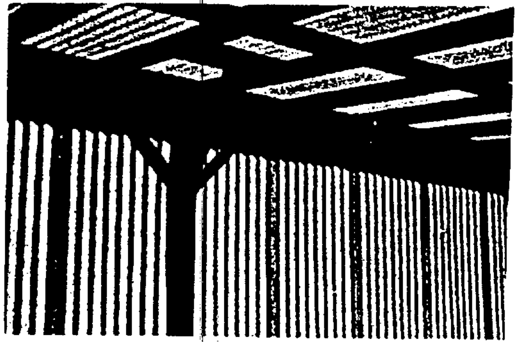
Because of Mrs. Hammid's artistic background, she was capable of drawing and describing visual images that she could not identify in any cognitive or analytic sense. When the target demarcation team went to a target location which was a pedestrian overpass, the subject said that she saw "a kind of trough up in the air," which she indicated in the upper part of her drawing in Fig. 4. She went on to explain, "If you stand where they are standing you will see something like this," indicating the nested squares at the bottom of Fig. 4. As it turned out, a judge standing where she indicated would have a view closely resembling what she had drawn, as can be seen from the accompanying photographs of the target location. It needs to be emphasized, however, that judges did not have access to our photographs of the site, used here for illustrative purposes only, but rather they proceeded to each of the target locations by list.

In another experiment, the subject described seeing "an open barnlike structure with a pitched roof." She also saw a "kind of slatted side to the structure making light and dark bars on the wall." Her drawing and a photograph of the associated bicycle shed target are shown in Fig. 5. (Subjects are encouraged to make drawings of anything they visualize and respond with, from experience, because drawings they make are in general more accurate than their verbal description.)

As in the original series with Price, the results of the nine-



BICYCLE SHED TARGET



DETAIL OF BICYCLE SHED

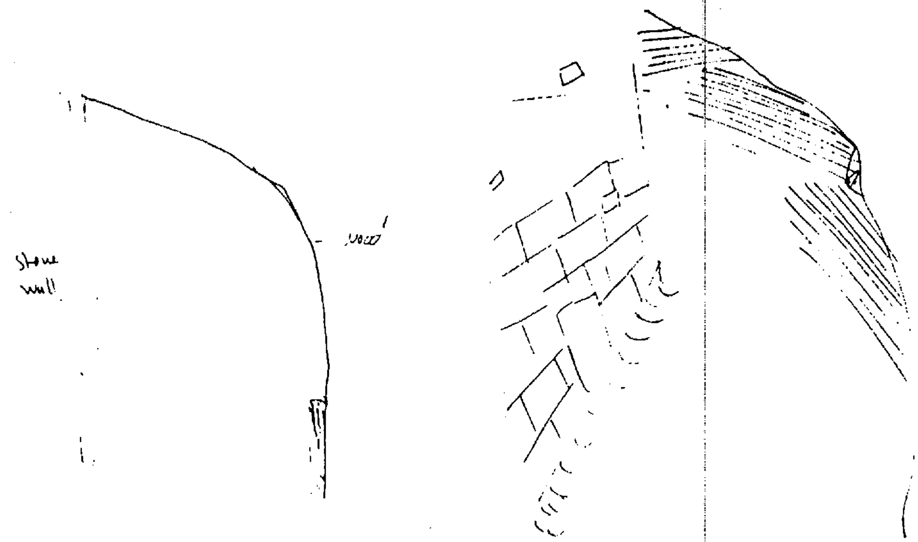


Fig. 5. Subject Hammid (S4) response to bicycle shed target described as an open "barn-like building" with "slats on the sides" and a "pitched roof."

TABLE III
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR LEARNER SUBJECT HAMMID (S4)

Target Location	Distance (km)	Rank of Associated Transcript
Methodist Church, Palo Alto	1.9	1
Ness Auditorium, Menlo Park	0.2	1
Merry-go-round, Palo Alto	3.4	1
Parking garage, Mountain View	8.1	2
SRI International Courtyard, Menlo Park	0.2	1
Bicycle shed, Menlo Park	0.1	2
Railroad trestle bridge, Palo Alto	1.3	2
Pumpkin patch, Menlo Park	1.3	1
Pedestrian overpass, Palo Alto	5.0	2
Total sum of ranks		13 ($p = 1.8 \times 10^{-6}$)

experiment series were submitted for independent judging on a blind basis by an SRI research analyst not otherwise associated with the research. While at each target location, visited in turn, the judge was required to blind rank order the nine unedited typed manuscripts of the tape-recorded narratives, along with any associated drawings generated by the remote viewer, on a scale 1 to 9 (best to worst match). The sum of ranks assigned to the target-associated transcripts in this case was 13, a result significant at $p = 1.8 \times 10^{-6}$ by exact calculation (see Table I and discussion), and in[illegible] direct hits and four second ranks (Table III).

Again, as a backup judging procedure, a panel of five additional judges not otherwise associated with the research were asked simply to blind match the unedited typed transcripts and associated drawings generated by the remote viewer, against the nine target locations which they independently visited in turn. A correct match consisted of a transcript of a given date being matched to the target of that date. Instead of the expected number of 1 match each per judge, the number of correct matches obtained by the five judges was 5, 3, 3, 2, and 2, respectively. Thus, rather than the expected total number of 5 correct matches from the judges, 15 such matches were obtained.

C. Subjects S2 and S3: Experienced

Having completed a series of 18 remote-viewing experiments, 9 each with experienced subject S1 (Price) and learner S4 (Hammid), additional replication experiments, four with each subject, were carried out with experienced subjects S2 (Elgin) and S3 (Swann) and learners S5 and S6. To place the judging on a basis comparable to that used with S1 and S4, the four transcripts each of experienced subjects S2 and S3 were combined into a group of eight for rank order judging to be compared with the similarly combined results of the learners S5 and S6.

The series with S2 (Elgin, an SRI research analyst) provided a further example of the dichotomy between verbal and drawing responses. (As with medical literature, case histories often are more illuminating than the summary of results.) The experiment described here was the third conducted with this

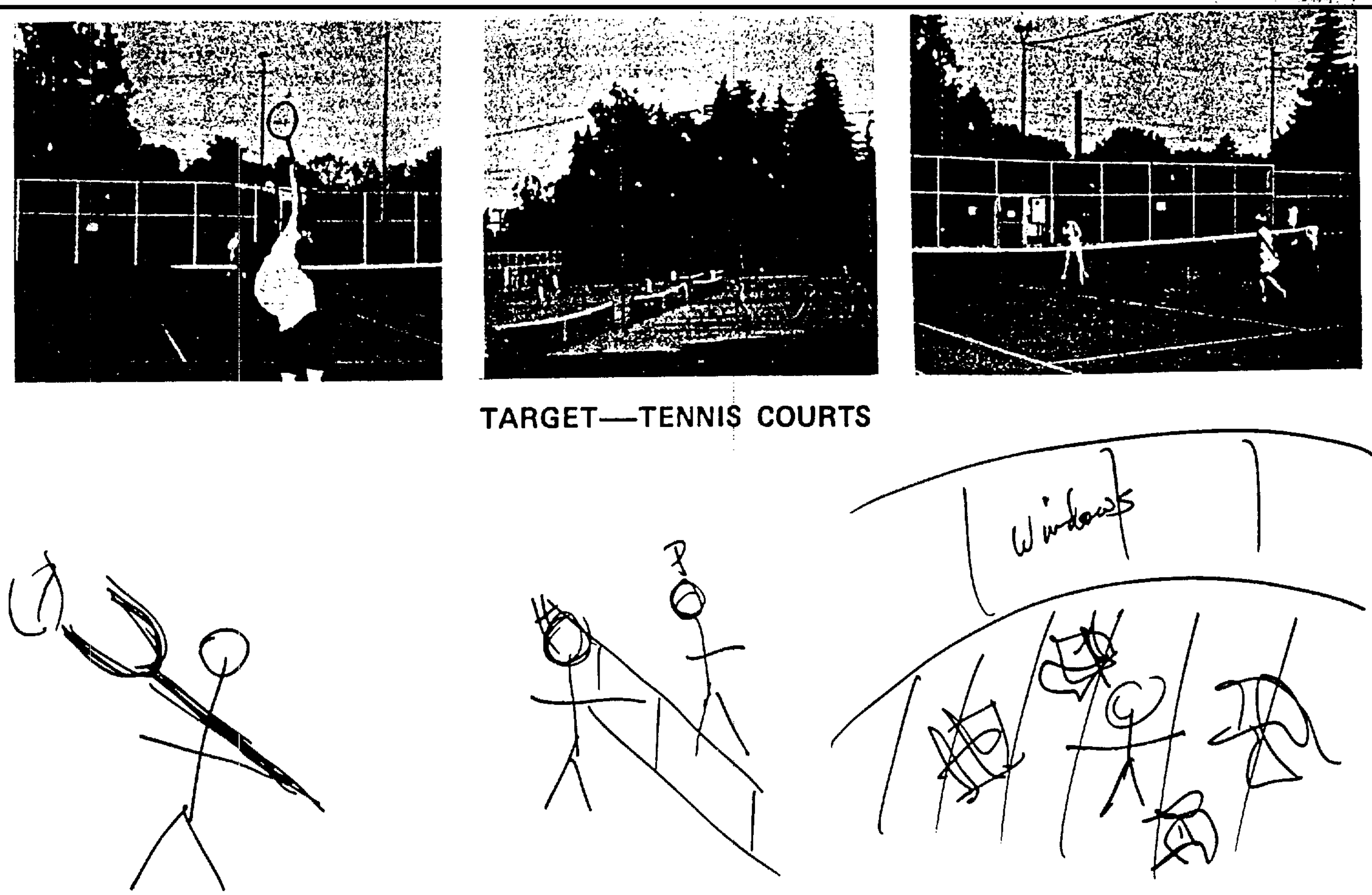


Fig. 6. Subject Elgin (S2) drawings in response to tennis court target.

subject. It was a demonstration experiment for a government visitor who had heard of our work and wanted to evaluate our experimental protocol.

In the laboratory, the subject, holding a bearing compass at arm's length, began the experiment by indicating the direction of the target demarcation team correctly to within 5°. (In all four experiments with this subject, he has always been within 10° of the correct direction in this angular assessment.) The subject then generated a 15-min tape-recorded description and the drawings shown in Fig. 6.

In discussing the drawings, Elgin indicated that he was uncertain as to the action, but had the impression that the demarcation team was located at a museum (known to him) in a particular park. In fact, the target was a tennis court located in that park about 90 m from the indicated museum. Once again, we note the characteristic (discussed earlier) of a resemblance between the target site and certain gestalt elements of the subject's response, especially in regard to the drawings, coupled with incomplete or erroneous analysis of the significances. Nonetheless, when rank ordering transcripts 1 through 8 at the site, the judge ranked this transcript as 2. This example illustrates a continuing observation that most of the correct information related to us by subjects is of a non-analytic nature pertaining to shape, form, color, and material rather than to function or name.

A second example from this group, generated by S3 (Swann), indicates the level of proficiency that can be attained with practice. In the two years since we first started working with Swann, he has been studying the problem of separating the external signal from the internal noise. In our most recent experiments, he dictates two lists for us to record. One list contains objects that he "sees," but does not think are located at the remote scene. A second list contains objects that he thinks are at the scene. In our evaluation, he has made much progress in this most essential ability to separate memory and imagination from paranormal inputs. This is the key to bringing the remote-viewing channel to fruition with regard to its potential usefulness.

The quality of transcript that can be generated by this process is evident from the results of our most recent experiment with Swann. The target location chosen by the usual double-blind protocol was the Palo Alto City Hall. Swann described a tall building with vertical columns and "set in" windows. His sketch, together with the photograph of the site, is shown in Fig. 7. He said there was a fountain, "but I don't hear it." At the time the target team was at the City Hall during the experiment, the fountain was not running. He also made an effort to draw a replica of the designs in the pavement in front of the building, and correctly indicated the number of trees (four) in the sketch.

For the entire series of eight, four each from S2 and S3, the numerical evaluation based on blind rank ordering of transcripts at each site was significant at $p = 3.8 \times 10^{-4}$ and included three direct hits and three second ranks for the target-associated transcripts (see Table IV).

D. Subjects S5 and S6: Learners

To complete the series, four experiments each were carried out with learner subjects S5 and S6, a man and woman on the SRI professional staff. The results in this case, taken as a

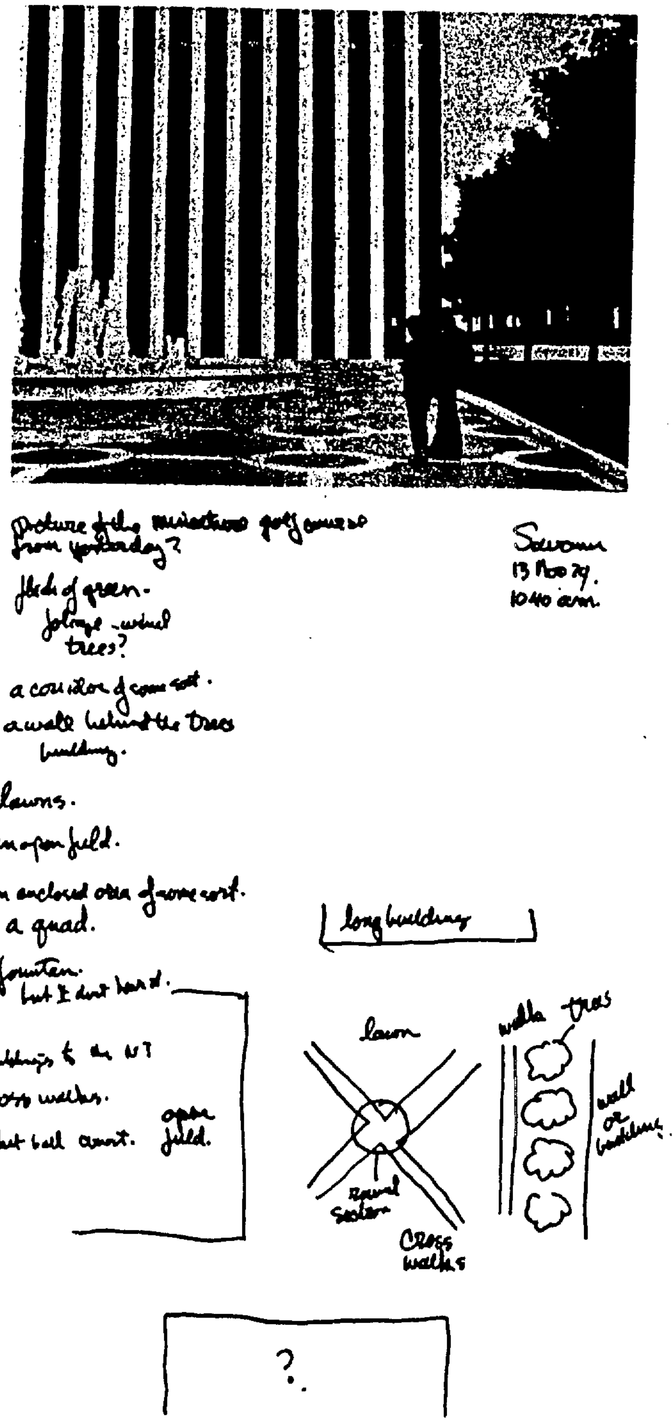


Fig. 7. Subject Swann (S3) response to City Hall target.

group, did not differ significantly from chance. For the series of eight (judged as a group of seven since one target came up twice, once for each subject), the numerical evaluation based on blind rank ordering of transcripts at each site was nonsignificant at $p = 0.08$, even though there were two direct hits and two second ranks out of the seven (see Table V).

One of the direct hits, which occurred with subject S6 in her *first* experiment, provides an example of the "first-time effect" that has been rigorously explored and is well-known to experimenters in the field [57]. The outbound experimenter obtained, by random protocol from the pool, a target blind to the experimenter with the subject, as is our standard procedure, and proceeded to the location. The subject, a mathematician in the computer science laboratory who had no pre-

TABLE IV
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR EXPERIENCED SUBJECTS ELGIN (S2) AND SWANN (S3)

Subject	Target Location	Distance (km)	Rank of Associated Transcript
S2	BART Station (Transit System), Fremont	16.1	1
S2	Shielded room, SRI, Menlo Park	0.1	2
S2	Tennis court, Palo Alto	3.4	2
S2	Golf course bridge, Stanford	3.4	2
S3	City Hall, Palo Alto	2.0	1
S3	Miniature golf course, Menlo Park	3.0	1
S3	Kiosk in park, Menlo Park	0.3	3
S3	Baylands Nature Preserve, Palo Alto	6.4	3
	Total sum of ranks		15 ($p = 3.8 \times 10^{-4}$)

TABLE V
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR LEARNER SUBJECTS S5 AND S6

Subject	Target Location	Distance (km)	Rank of Associated Transcript
S5	Pedestrian overpass, Palo Alto	5.0	3
S5	Railroad trestle bridge, Palo Alto	1.3	6
S5	Windmill, Portola Valley	8.5	2
S5, S6	White Plaza, Stanford (2)	3.8	1
S6	Airport, Palo Alto	5.5	2
S6	Kiosk in Park, Menlo Park	0.3	5
S6	Boathouse, Stanford	4.0	1
	Total sum of ranks		20 ($p = 0.08$, NS)

vious experience in remote viewing, began to describe a large square with a fountain. Four minutes into the experiment, she recognized the location and correctly identified it by name (see Fig. 8). (It should be noted that in the area from which the target locations were drawn there are other fountains as well, some of which were in the target pool.) As an example of the style of the narratives generated during remote viewing with inexperienced subjects and of the part played by the experimenter remaining with the subject in such a case, we have included the entire unedited text of this experiment as Appendix B.

E. Normal and Paranormal: Use of Unselected Subjects in Remote Viewing

After more than a year of following the experimental protocol described above and observing that even inexperienced subjects generated results better than expected, we initiated a series of experiments to explore further whether individuals other than putative "psychics" can demonstrate the remote-viewing ability. To test this idea, we have a continuing program to carry out additional experiments of the outdoor type with new subjects whom we have no *a priori* reason to believe have paranormal perceptual ability. To date we have collected data from five experiments with two individuals in this category: a man and a woman who were visiting government scientists interested in observing our experimental protocols. The motivation for these particular experiments was twofold. First, the experiments were designed to indicate the level of proficiency that can be expected from unselected volunteers.

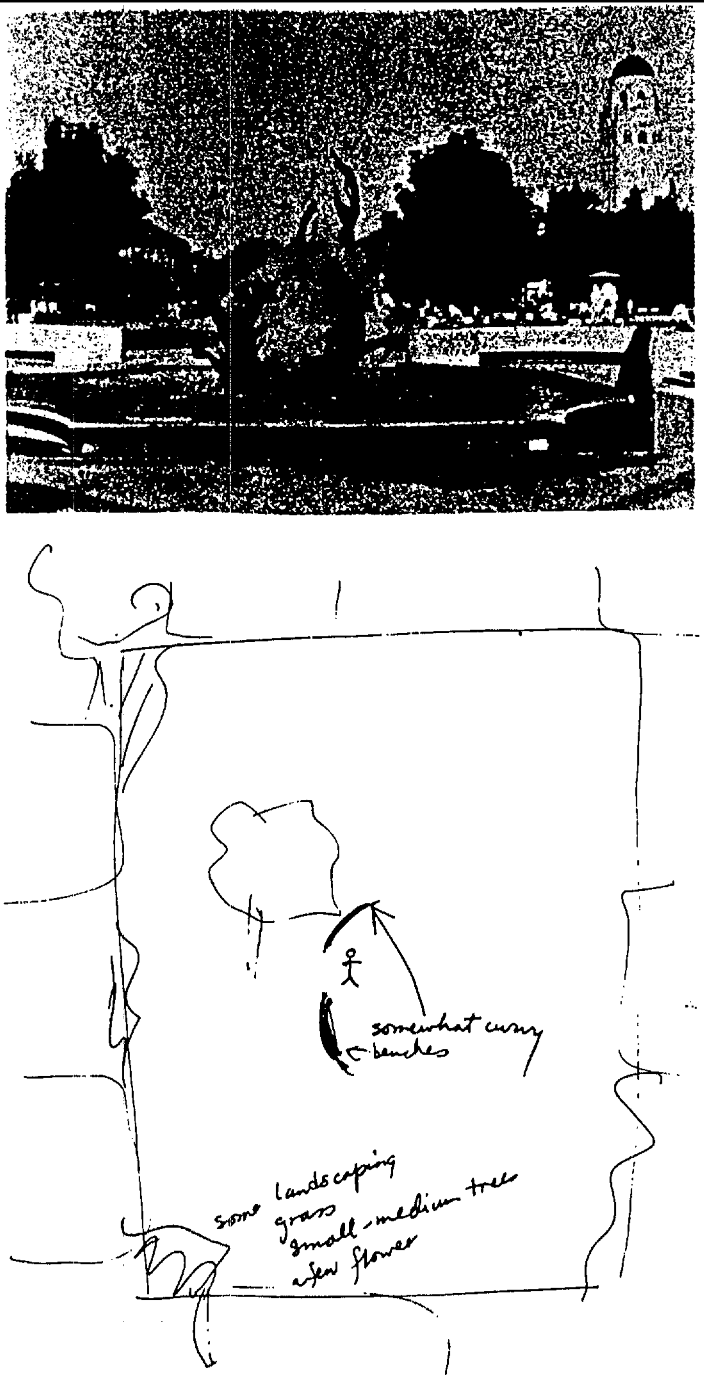
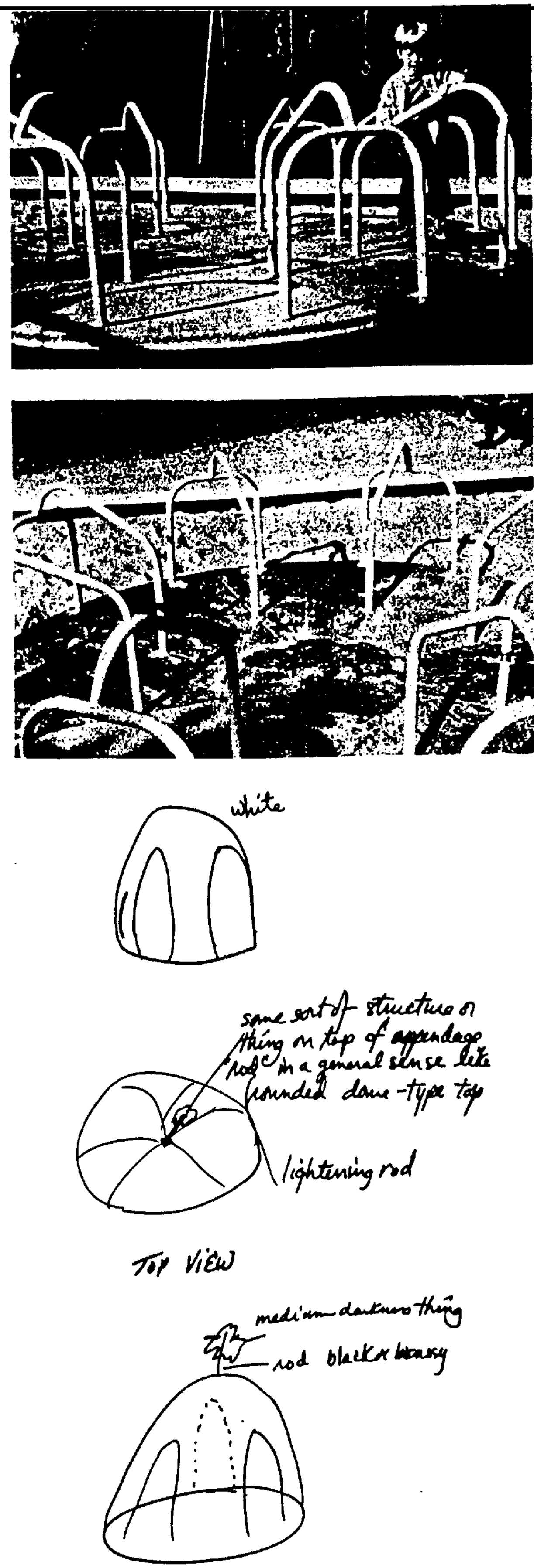


Fig. 8. Subject (S6) drawing of White Plaza, Stanford University. Subject drew what she called "curvy benches" and then announced correctly that the place was "White Plaza at Stanford."

Second, when an individual observes a successful demonstration experiment involving another person as subject, it inevitably occurs to him that perhaps chicanery is involved. We have found the most effective way to settle this issue for the observer is to have the individual himself act as a subject so as to obtain personal experience against which our reported results can be evaluated.

The first visitor (V1) was invited to participate as a subject in a three-experiment series. All three experiments contained elements descriptive of the associated target locations; the quality of response increased with practice. The third response is shown in Fig. 9, where again the pattern elements in the drawing appeared to be a closer match than the subject's analytic interpretation of the target object as a cupola.



RESPONSES OF VISITING

Fig. 9. Subject (V1) drawing of merry-go-round target.

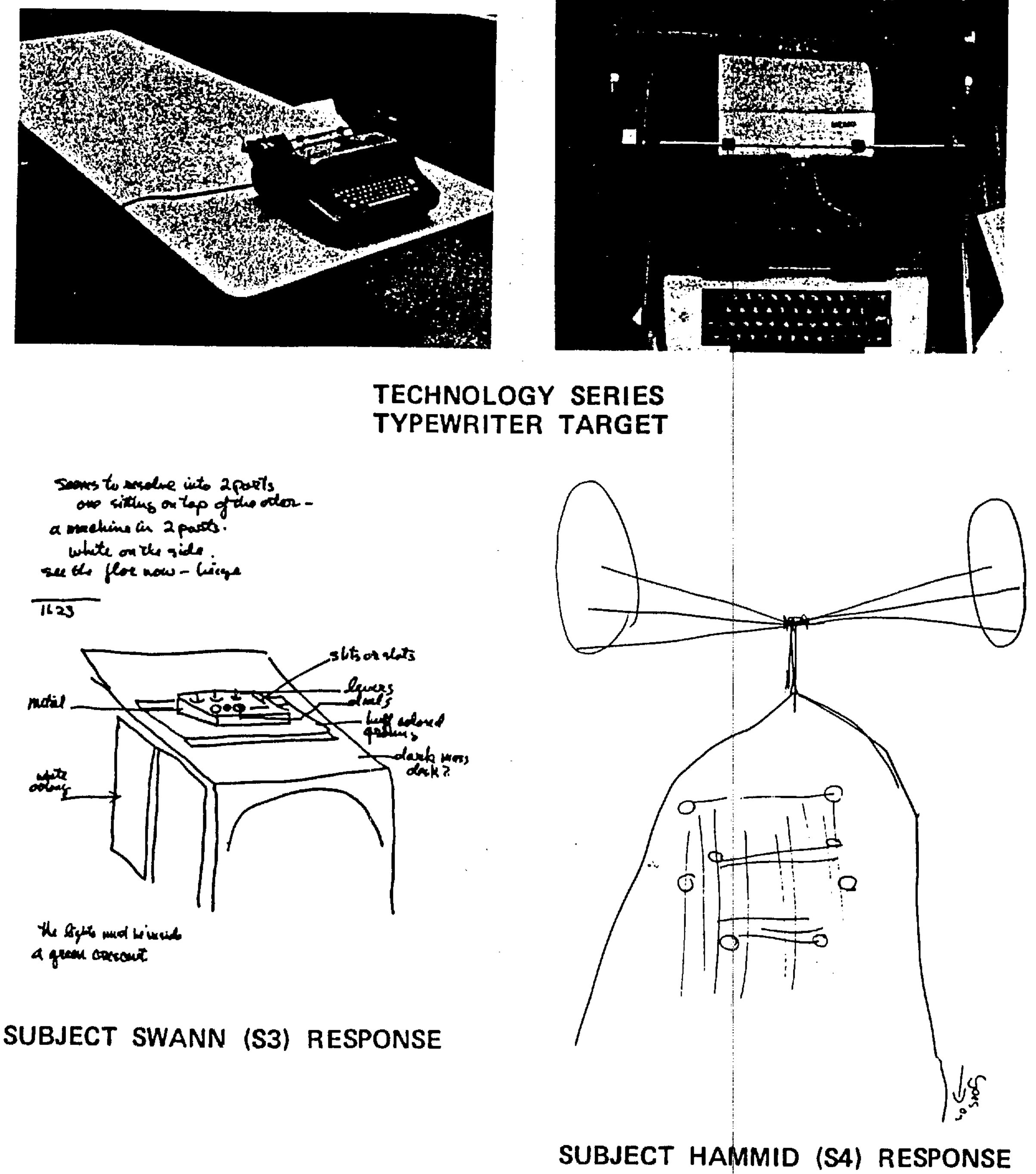


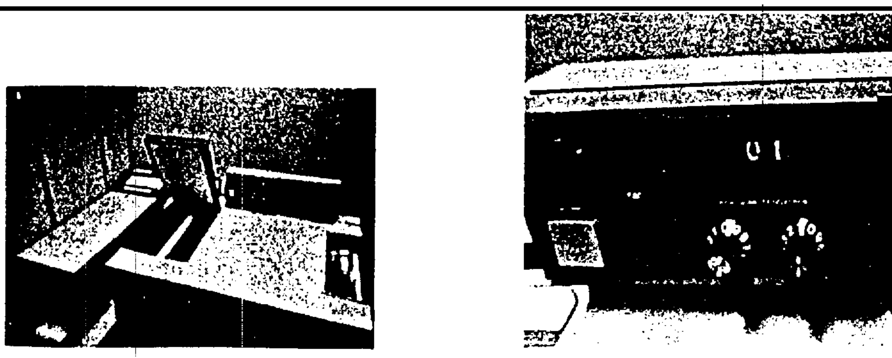
Fig. 10. Drawings of a typewriter target by two subjects.

The second visitor [V2] participated as a subject in two experiments. In his first experiment, he generated one of the higher signal-to-noise results we have observed. He began his narrative, "There is a red A-frame building and next to it is a large yellow thing [a tree–Editor]. Now further left there is another A-shape. It looks like a swing-set, but it is pushed down in a gully so I can't see the swings." [All correct.] He then went on to describe a lock on the front door that he said "looks like it's made of laminated steel, so it must be a Master lock." [Also correct.]

For the series of five–three from the first subject and two from the second–the numerical evaluation based on blind rank ordering of the transcripts at each site was significant at $p = 0.017$ and included three direct hits and one second rank for the target-associated transcripts. (See Table VI.)

TABLE VI
DISTRIBUTION OF RANKINGS ASSIGNED TO TRANSCRIPTS ASSOCIATED WITH EACH TARGET LOCATION FOR VISITOR SUBJECTS V1 AND V2

Subject	Target Location	Distance (km)	Rank of Associated Transcript
V1	Bridge over stream, Menlo Park	0.3	1
V1	Baylands Nature Preserve, Palo Alto	6.4	2
V1	Merry-go-round, Palo Alto	3.4	1
V2	Windmill, Portola Valley	8.5	1
V2	Apartment swimming pool, Mountain View	9.1	3
	Total sum of ranks		8 (p=0.017)



TARGET LOCATION: XEROX MACHINE (TECHNOLOGY SERIES)

TO ADD INTEREST TO TARGET LOCATION EXPERIMENTER WITH HIS HEAD BEING XEROXED

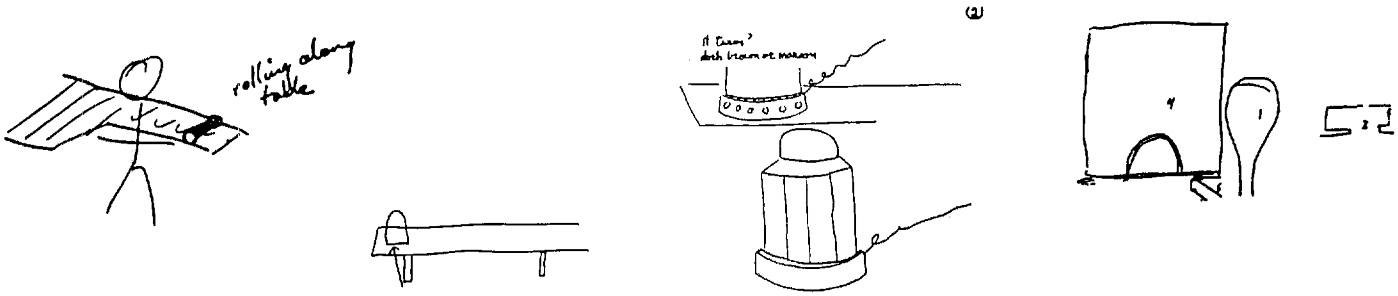


Fig. 11. Drawings by three subjects (S2, S3, and V3) for Xerox machine target. When asked to describe the square at upper left of response on the right, subject (V3) said, "There was this predominant light source which might have been a window, and a working surface which might have been the sill, or a working surface or desk." Earlier the subject had said, "I have the feeling that there is something silhouetted against the window."

Observations with unselected subjects such as those described above indicate that remote viewing may be a latent and widely distributed perceptual ability.

F. Technology Series: Short-Range Remote Viewing

Because remote viewing is a perceptual ability, we considered it important to obtain data on its resolution capabilities. To accomplish this, we turned to the use of indoor technological targets.

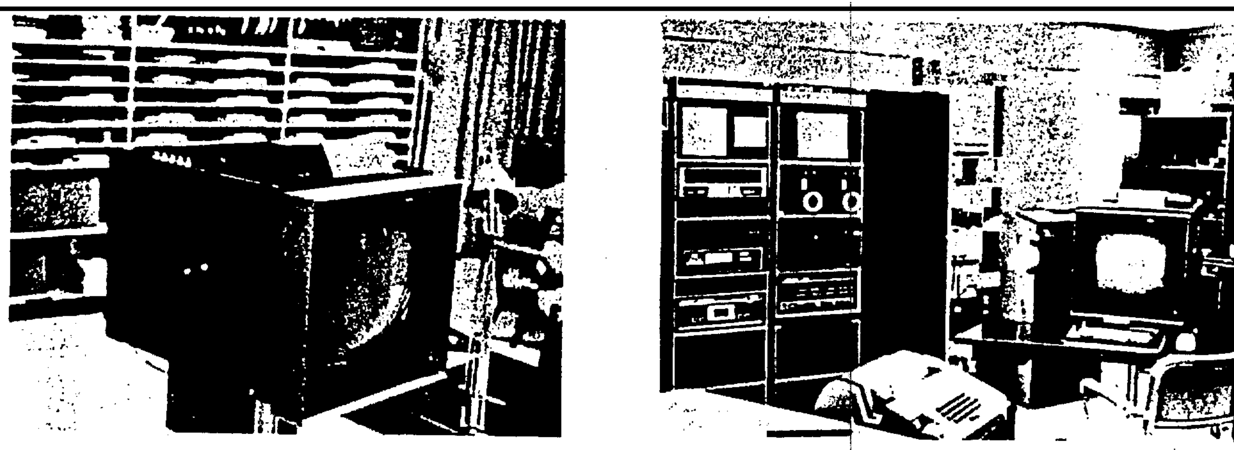
Twelve experiments were carried out with five different subjects, two of whom were visiting government scientists. They were told that one of the experimenters would be sent by random protocol to a laboratory within the SRI complex and that he would interact with the equipment or apparatus at that location. It was further explained that the experimenter remaining with the subject was, as usual, kept ignorant of the contents of the target pool to prevent cueing during questioning. (Unknown to subjects, targets in the pool were used with replacement; one of the goals of this particular experiment was to obtain multiple responses to a given target to investigate whether correlation of a number of subject responses would provide enhancement of the signal-to-noise ratio.) The subject was asked to describe the target both verbally (tape recorded) and by means of drawings during a time-synchronized 15-min interval in which the outbound experimenter interacted in an appropriate manner with the equipment in the target area.

In the twelve experiments, seven targets were used: a drill press, Xerox machine, video terminal, chart recorder, four-state random number generator, machine shop, and typewriter. Three of these were used twice (drill press, video terminal, and [illegible]) and one (the [illegible]) came up three times in our random selection procedure.

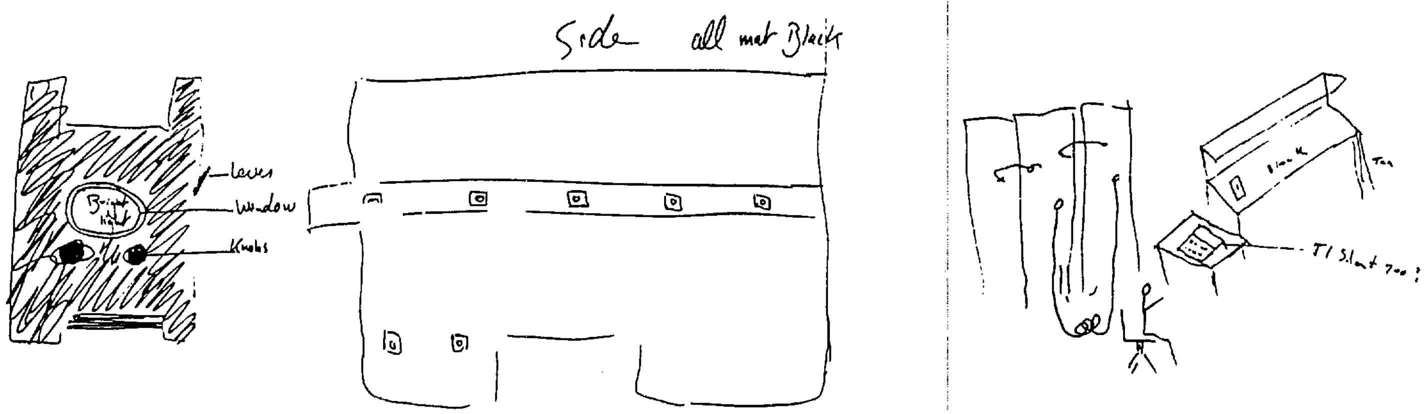
Comparisons of the targets and subject drawings for three of the multiple-response cases (the typewriter, Xerox machine, and video terminal) are shown in Figs. 10, 11, and 12. As is apparent from these illustrations alone, the experiments provide circumstantial evidence for an information channel of useful bit rate. This includes experiments in which visiting government scientists participated as subjects (Xerox machine and video terminal) to observe the protocol. In general, it appears that use of multiple-subject responses to a single target provides better signal-to-noise ratio than target identification by a single individual. This conclusion is borne out by the judging described below.

Given that in general the drawings constitute the most accurate portion of a subject's description, in the first judging procedure a judge was asked simply to blind match only the drawings (i.e., without tape transcripts) to the targets. Multiple-subject responses to a given target were stapled together, and thus seven subject-drawing response packets were to be matched to the seven different targets for which drawings were made. The judge did *not* have access to our photographs of the target locations, used for illustration purposes only, but rather proceeded to each of the target locations by list. While standing at each target location, the judge was required to rank order the seven subject-drawing response packets (presented in random order) on a scale 1 to 7 (best to worst match). For seven targets, the sum of ranks could range from 7 to 49. The sum in this case, which included 1 direct hit and 4 second ranks out of the 7 (see Table VII) was 18, a result significant at $p = 0.036$.

In the second more detailed effort at evaluation, a visiting scientist selected at random one of the 12 data packages ([illegible]) and submitted it for independent analysis to an engineer with a request for an esti-



TARGET: VIDEO MONITOR FOR TEXT EDITING (TECHNOLOGY SERIES)



(a) (b)

Fig. 12. Drawing by two subjects of a video monitor target. (a) Subject (S4) drawing of "box with light coming out of it . . . painted flat black and in the middle of the room." (b) Second subject (V2) saw a computer terminal with relay racks in the background.

TABLE VII
DISTRIBUTION OF RANKINGS ASSIGNED TO SUBJECT DRAWINGS ASSOCIATED WITH EACH TARGET LOCATION

Subject	Target	Rank of Associated Drawings
S3, S4	Drill press	2
S2, S3, V3	Xerox machine	2
S4, V2	Video terminal	1
S3	Chart recorder	2
S4	Random number generator	6
S4	Machine shop	3
S3, S4	Typewriter	2
	Total sum of ranks	18 (p=0.036)

TABLE VIII
SUMMARY: REMOTE VIEWING

Subject	Number of Experiments	p-Value, Rank Order Judging
With natural targets		
S1 (experienced)	9	2.9×10^{-5}
S2 and S3 (experienced)	8	3.8×10^{-4}
S4 (learner)	9	1.8×10^{-6}
S5 and S6 (learners)	8	0.08 (NS)
V1 and V2 (learners/visitors)	5	0.017
With technology targets		
S2, S3, S4, V2, V3	12	0.036

mate as to what was being described. The analyst, blind as to the target and given only the subject's taped narrative and drawing (Fig. 13), was able, from the subject's description alone, to correctly classify the target as a "man-sized vertical boring machine."

G. Summary of Remote Viewing Results

1) Discussion: The descriptions supplied by the subjects in the experiments involving remote viewing of natural targets or laboratory apparatus, although containing inaccuracies, were sufficiently accurate to permit the judges to differentiate among various targets to the degree indicated. A summary tabulation of the statistical evaluations of these fifty-one experiments with nine subjects is presented in Table VIII. The overall result, evaluated conservatively on the basis of a judging procedure that ignores transcript quality beyond that necessary to rank order the data packets (vastly underestimating the statistical significance of individual descriptions), clearly indicates the presence of an information channel of useful bit rate. Furthermore, it appears that the principal difference between experienced subjects and inexperienced volunteers is *not* that the latter never exhibit the faculty, but rather that their results are simply less reliable, more sporadic. Nevertheless, as described earlier, individual transcripts from the inexperienced group of subjects number among some of the best obtained. Such observations indicate a hypothesis that remote viewing may be a latent and widely distributed perceptual ability.

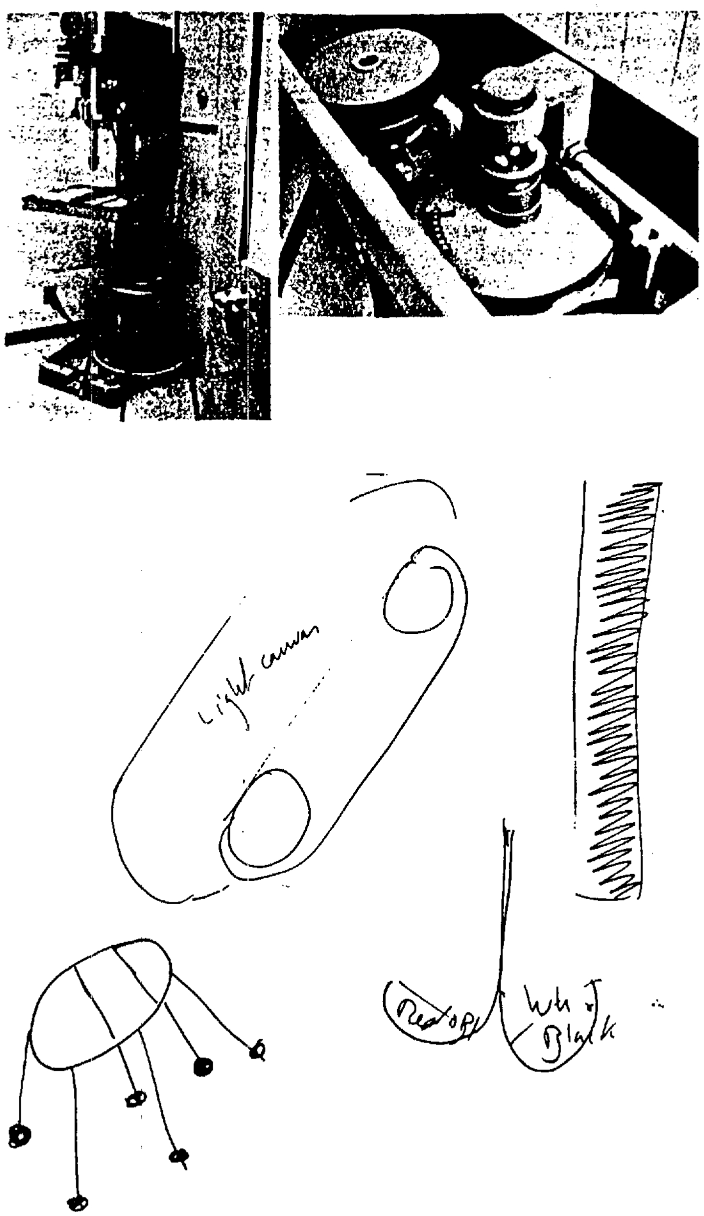


Fig. 13. Subject (S4) drawing of drill press showing belt drive, stool, and a "vertical graph that goes up and down."

Thus the primary achievement of the SRI program was the elicitation of high-quality remote viewing from individuals who agreed to act as subjects. Criticism of this claim could in principle be put forward on the basis of three potential flaws. 1) The study could involve naiveté in protocol that permits various forms of cueing, intentional or unintentional. 2) The experiments discussed could be selected out of a larger pool of experiments of which many are of poorer quality. 3) Data for the reported experiments could be edited to show only the matching elements, the nonmatching elements being discarded.

All three criticisms, however, are invalid. First, with regard to cueing, the use of double-blind protocols ensures that none of the persons in contact with the subject can be aware of the target. Second, selection of experiments for reporting did not take place; every experiment was entered as performed on a master log and is included in the statistical evaluations. Third, data associated with a given experiment remain unedited; all experiments are tape recorded and all data are included unedited in the data package to be judged and evaluated.

In the process of judging—attempting to match transcripts against targets on the basis of the information in the transcripts—some patterns and regularities in the transcript descriptions became evident, particularly regarding individual styles in remote viewing and in the perceptual form of the descriptions given by the subjects. These patterns and the judging procedure are discussed below.

a) Styles of response: The fifty-one transcripts were taken from nine different subjects. Comparing the transcripts of one subject with those of another revealed that each pattern tended to focus on certain aspects of the remote target complex and to exclude others, so that each had an individual pattern of response, like a signature.

Subject S3, for example, frequently responded with topographical descriptions, maps, and architectural features of the target locations. Subject S2 often focused on the behavior of the remote experimenter or the sequence of actions he carried out at the target. The transcripts of subject S4, more than those of other subjects, had descriptions of the feel of the location, and experiential or sensory gestalts—for example, light/dark elements in the scene and indoor/outdoor and enclosed/open distinctions. Prominent features of S1's transcripts were detailed descriptions of what the target persons were concretely experiencing, seeing, or doing—for example, standing on asphalty blacktop overlooking water; looking at a purple iris.

The range of any individual subject's responses was wide. Anyone might draw a map or describe the mood of the remote experimenter, but the consistency of each subject's overall approach suggests that just as individual descriptions of a *directly* viewed scene would differ, so these differences also occur in *remote*-viewing processes.

b) Nature of the description: The concrete descriptions that appear most commonly in transcripts are at the level of subunits of the overall scene. For example, when the target was a Xerox copy machine, the responses included (S2) a rolling object (the moving light) or dials and a cover that is lifted (S3), but the machine as a whole was not identified by name or function.

In a few transcripts, the subjects correctly identified and named the target. In the case of a computer terminal, the subject (V2) apparently perceived the terminal and the relay racks behind it. In the case of targets which were Hoover Tower and White Plaza, the subjects (S1 and S6, respectively) seemed to identify the locations through analysis of their initial images of the elements of the target.

There were also occasional incorrect identifications. Gestalts were incorrectly named; for example, swimming pools in a park were identified as water storage tanks at a water filtration plant (S1).

The most common perceptual level was thus an intermediate one—the individual elements and items that make up the target. This is suggestive of a scanning process that takes sample perceptions from within the overall environment.

When the subjects tried to make sense out of these fragmentary impressions, they often resorted to metaphors or constructed an image with a kind of perceptual inference. From a feeling of the target as an "august" and "solemn" building, a subject (S4) said it might be a library; it was a church. A pedestrian overpass above a freeway was described as a conduit (S4). A rapid transit station, elevated above the countryside, was associated with an observatory (S2). These responses seem to be the result of attempts to process partial information: similarly, this occurs in other parapsychological experiments. These observations are compatible with the hypotheses that information received in a putative remote-viewing mode is processed piecemeal in pattern form (consistent with a low bit rate process, but not necessarily requiring it); and the errors arise in the processes of attempted integration of the data into larger patterns directed toward verbal labeling.

When the subjects augmented the verbal transcripts with drawings or sketches, these often expressed the target elements more accurately than the verbal descriptions. Thus the drawings tended to correspond to the targets more clearly and precisely than the words of the transcript.

The descriptions given by the subjects sometimes went beyond what the remote experimenter experienced, at least consciously. For example, one subject (S4) described and drew a belt drive at the top of a drill press that was invisible even to the remote experimenter who was operating the machine; another subject (S1) described a number of items behind shrubbery and thus not visible to members of the demarcation team at the site.

Curiously, objects in motion at the remote site were rarely mentioned in the transcript. For example, trains crossing the railroad trestle target were not described, though the remote experimenter stood very close to them.

Also in a few cases, the subject descriptions were inaccurate regarding size of structures. A 20-ft courtyard separating two buildings was described as 200 ft wide, and a small shed was expanded to a barn-like structure.

c) Blind judging of transcripts: The judging procedure entailed examining the transcripts for a given experimental series and attempting to match the transcripts with the correct targets on the basis of their correspondences. The transcripts varied from coherent and accurate descriptions to mixtures of correspondences and noncorrespondences. Since the judge did not know *a priori* which elements of the descriptions were correct or incorrect, the task was complicated, and transcripts often seemed plausibly to match more than one target. A confounding factor in these studies is that some target locations have similarities that seem alike at some level of perception. For example, a radio telescope at the top of a hill, the observation deck of a tower, and a jetty on the edge of a bay all match a transcript description of "looking out over a long distance." A lake, a fountain, and a creek may all result in an image of water for the subject. Therefore, in several cases, even correct images may not help in the conservative differential matching procedure used.

According to the judge, the most successful procedure was a careful element-by-element comparison that tested each transcript against every target and used the transcript descriptions and drawings as arguments for or against assigning the transcript to a particular target. In most cases, this resulted in either a clear conclusion or at least a ranking of probable matches; these matches were subjected to the statistical analyses presented in this paper.

2) Summary: In summary, we do not yet have an understanding of the nature of the information-bearing signal that a subject perceives during remote viewing. The subjects commonly report that they perceive the signal visually as though they were looking at the object or place from a position in its immediate neighborhood. Furthermore, the subjects' perceptual viewpoint has mobility in that they can shift their point of view so as to describe elements of a scene that would not be visible to an observer merely standing at ground level and describing what he sees. (In particular, a subject often correctly describes elements not visible to the target demarcation team.) Finally, motion is seldom reported; in fact, moving objects often are unseen even when nearby static objects are correctly identified.

A comparison of the results of remote viewing (a so-called free-response task) with results of forced-choice tasks, such as the selection of one of four choices generated by a random number generator [58], reveals the following findings. From a statistical viewpoint, a subject is more likely to describe, with sufficient accuracy to permit blind matching, a remote site chosen at random than he is to select correctly one of four random numbers. Our experience with these phenomena leads us to consider that this difference in task performance may stem from fundamental signal-to-noise considerations. Two principal sources of noise in the system apparently are memory and imagination, both of which can give rise to mental pictures of greater clarity than the target to be perceived. In the random number task, a subject can create a perfect mental picture of each of the four possible outputs in his own imagination and then attempt to obtain the correct answer by a mental matching operation. The same is true for card guessing experiments. On the other hand, the subject in remote viewing is apparently more likely to approach the task with a blank mind as he attempts to perceive pictorial information from remote locations about which he may have no stored mental data.

Finally, we observe that most of the correct information that subjects relate to us is of a nonanalytic nature pertaining to shape, form, color, and material rather than to function or name. In consultation with Dr. Robert Ornstein of the Langley–Porter Neuropsychiatric Institute, San Francisco, CA, and with Dr. Ralph Kiernan of the Department of Neurology, Stanford University Medical Center, Stanford, CA, we have formed the tentative hypothesis that paranormal functioning may involve specialization characteristic of the brain's right hemisphere. This possibility is derived from a variety of evidence from clinical and neurosurgical sources which indicate that the two hemispheres of the human brain are specialized for different cognitive functions. The left hemisphere is predominantly active in verbal and other analytical functioning and the right hemisphere predominates in spatial and other holistic processing [59], [60]. Further research is necessary to elucidate the relationship between right hemisphere function and paranormal abilities. Nonetheless, we can say at this point that the remote-viewing results of the group of subjects at SRI have characteristics in common with more familiar performances that require right hemispheric function. The similarities include the highly schematicized drawings of objects in a room or of remote scenes. Verbal identification of these drawings is often highly inaccurate and the drawings themselves are frequently left–right reversed relative to the target configuration. Further, written material generally is not cognized. These characteristics have been seen in left brain-injured patients and in callosal-sectioned patients.

As a result of the above considerations, we have learned to urge our subjects simply to describe what they see as opposed to what they think they are looking at. We have learned that their unanalyzed perceptions are almost always a better guide to the true target than their interpretations of the perceived data.

IV. Considerations Concerning Time

If the authors may be forgiven a personal note, we wish to express that this section deals with observations that we have been reluctant to publish because of their striking apparent incompatibility with existing concepts. The motivating factor for presenting the data at this time is the ethical consideration that theorists endeavoring to develop models for paranormal functioning should be apprised of all the observable data if their efforts to arrive at a comprehensive and correct description are to be successful.

During the course of the experimentation in remote viewing (Section III), subjects occasionally volunteered the information that they had been thinking about their forthcoming participation in a remote-viewing experiment and had an image come to them as to what the target location was to be. On these occasions, the information was given only to the experimenter remaining at SRI with the subject and was unknown to the outbound experimenter until completion of the experiment. Two of these contributions were among the most accurate descriptions turned in during those experiments. Since the target location had not yet been selected when the subject communicated his perceptions about the target, we found the data difficult to contend with.

We offer these spontaneous occurrences not as proof of precognitive perception, but rather as the motivation that led us to do further work in this field. On the basis of this firsthand evidence, together with the copious literature describing years of precognition experiments carried out in various other laboratories, we decided to determine whether a subject could perform a perceptual task that required both spatial and temporal remote viewing.

It is well known and recently has been widely discussed that nothing in the fundamental laws of physics forbids the apparent transmission of information from the future to the present (discussed further in Section V). Furthermore, there is a general dictum that "in physical law, everything that is not forbidden, is required" [61]. With this in mind, we set out to conduct very well-controlled experiments to determine whether we could deliberately design and execute experiments for the sole purpose of observing precognition under laboratory conditions.

The experimental protocol was identical to that followed in previous remote-viewing experiments with but one exception. The exception was that the subject was required to describe the remote location during a 15-min period beginning 20 min before the target was selected and 35 min before the outbound experimenter was to arrive at the target location.

In detail, as shown in Table IX, each day at ten o'clock one of the experimenters would leave SRI with a stack of ten sealed envelopes from a larger pool and randomized daily, containing traveling instructions that had been prepared, but that were unknown to the two experimenters remaining with the subject. The subject for this experiment was Hella Hammid (S4) who participated in the nine-experiment series replicating the original Price work described earlier. The traveling experimenter was to drive continuously from 10:00 until 10:30 before selecting his destination with a random number generator. (The motivation for continuous motion was our observation that objects and persons in rapid motion are not generally seen in the remote-viewing mode of perception, and we wished the traveler to be a poor target until he reached his target site.) At the end of 3[illegible]

TABLE IX
Experimental Protocol: Precognitive Remote Viewing

Time Schedule	Experimenter/Subject Activity
10:00	Outbound experimenter leaves with 10 envelopes (containing target locations) and random number generator; begins half-hour drive
10:10	Experimenters remaining with subject in the laboratory elicit from subject a description of where outbound experimenter will be from 10:45-11:00
10:25	Subject response completed, at which time laboratory part of experiment is over
10:30	Outbound experimenter obtains random number from a random number generator, counts down to associated envelope, and proceeds to target location indicated
10:45	Outbound experimenter remains at target location for 15 minutes (10:45-11:00)

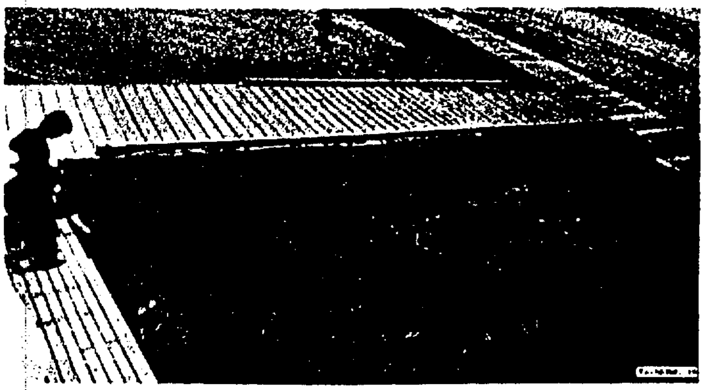


Fig. 14. Subject Hammid (S4) described "some kind of congealing tar, or maybe an area of condensed lava . . . that has oozed out to fill up some kind of boundaries."

ated a random digit from 0 to 9 with a Texas Instruments SR-51 random number generator; while still in motion, he counted down that number of envelopes and proceeded directly to the target location so as to arrive there by 10:45. He remained at the target site until 11:00, at which time he returned to the laboratory, showed his chosen target name to a security guard, and entered the experimental room.

During the same period, the protocol in the laboratory was as follows. At 10:10, the subject was asked to begin a description of the place to which the experimenter would go 35 min hence. The subject then generated a tape-recorded description and associated drawings from 10:10 to 10:25, at which time her part in the experiment was ended. Her description was thus entirely concluded 5 min before the beginning of the target selection procedure.

Four such experiments were carried out. Each of them appeared to be successful, an evaluation later verified in blind judging without error by three judges. We will briefly summarize the four experiments below.

The first target, the Palo Alto Yacht Harbor, consisted entirely of mud flats because of an extremely low tide (see Fig. 14). Appropriately, the entire transcript of the subject pertained to "some kind of congealing tar, or maybe an area of condensed lava. It looks like the whole area is covered with some kind of wrinkled elephant skin that has oozed out to fill up some kind of boundaries where (the outbound experimenter) is standing." Because of the lack of water, the dock where the remote experimenter was standing was in fact rest-

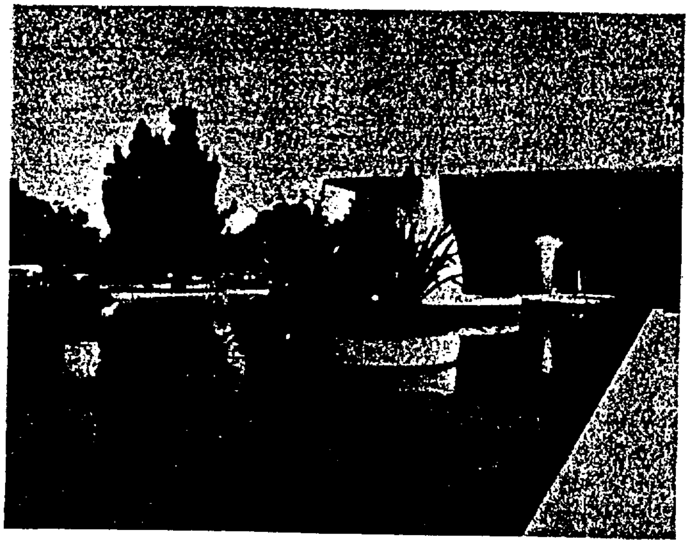


Fig. 16. Subject (S4) saw a "black iron triangle that Hal had somehow walked into" and heard a "squeak, squeak, about once a second."

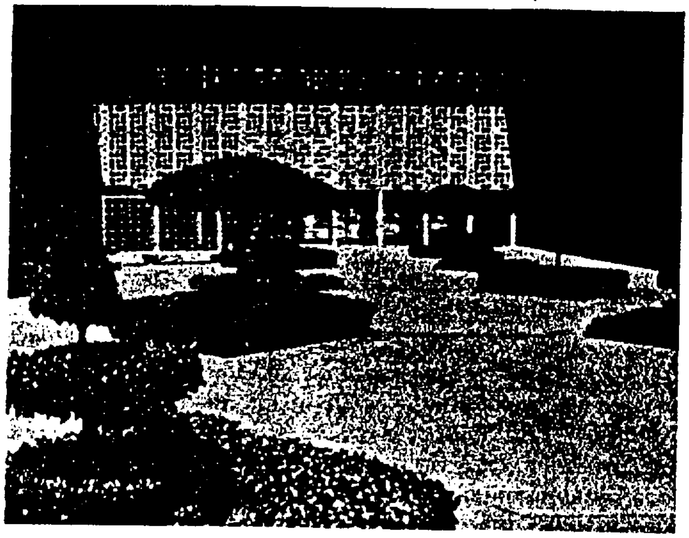


Fig. 15. Subject (S4) described a formal garden "very well manicured" behind a double colonnade.

Fig. 17. Subject (S4) described a very tall structure located among city streets and covered with "Tiffany-like glass."

Note that the subject has learned not to rush into interpretation as to the nature or purpose of the place. This is a result of our cautioning based on the observation that such efforts tend to be purely analytical and in our experience are almost invariably incorrect. If a subject can limit himself to what he sees, he is often then able to describe a scene with sufficient accuracy that an observer can perform the analysis for him and identify the place.

The second target visited was the fountain at one end of a large formal garden at Stanford University Hospital (Fig. 15). The subject gave a lengthy description of a formal garden behind a wall with a "double colonnade" and "very well manicured." When we later took the subject to the location, she was herself taken aback to find the double colonnaded wall leading into the garden just as described.

The third target was a children's swing at a small park 4.6 km from the laboratory (Fig. 16). The subject repeated again and again that the main focus of attention at the site was a "black iron triangle that the outbound experimenter had somehow walked into or was standing on." The triangle was "bigger than a man," and she heard a "squeak, squeak, about once a second," which we observe is a match to the black metal swing that did squeak.

The final target was the Palo Alto City Hall (Fig. 17). The subject described a very, very tall structure covered with "Tiffany-like glass." She had it located among city streets and with little cubes at the base. The building is glass-covered, and the little cubes are a good match to the small elevator exit buildings located in the plaza in front of the building.

To obtain a numerical evaluation of the accuracy of the precognitive viewing, the experimental results were subjected to independent judging on a blind basis by three SRI scientists who were not otherwise associated with the experiment. The judges were asked to match the four locations, which they visited, against the unedited typed manuscripts of the tape-recorded narratives, along with the drawings generated by the remote viewer. The transcripts were presented unlabeled and in random order and were to be used without replacement. A correct match required that the transcript of a given experiment be matched with the target of that experiment. All three judges independently matched the target data to the response data without error. Under the null hypothesis (no information channel and a random selection of descriptions without replacement), each judge independently obtained a result significant at $p = (4!)^{-1} = 0.042$.

For reasons we do not as yet understand, the four transcripts generated in the precognition experiment show exceptional coherence and accuracy as evidenced by the fact that all of the judges were able to match successfully all of the transcripts to the corresponding target locations. A long-range experimental program devoted to the clarification of these issues and involving a number of subjects is under way. The above four experiments are the first four carried out under this program.

Currently, we have no precise model of this spatial and temporal remote-viewing phenomenon. However, models of the universe involving higher order synchronicity or correlation have been proposed by the physicist Pauli and the psychologist Carl Jung [62].

> ACAUSALITY. If natural law[5] were an absolute truth, then of course there could not possibly be any processes that deviate from it. But since causality[5] is a *statistical* truth, it holds good only on average and thus leaves room for *exceptions* which must somehow be experienceable, that is to say, *real*. I try to regard synchronistic events as acausal exceptions of this kind. They prove to be relatively independent of space and time; they relativize space and time insofar as space presents in principle no obstacle to their passage and the sequence of events in time is inverted so that it looks as if an event which has not yet occurred were causing a perception in the present.

We shall see in the next section that such a description, though poetic, has some basis in modern physical theory.

V. Discussion

It is important to note at the outset that many contemporary physicists are of the view that the phenomena that we have been discussing are not at all inconsistent with the framework of physics as currently understood. In this emerging view, the often-held belief that observations of this type are incompatible with known laws *in principle* is erroneous, such a concept being based on the naive realism prevalent before the development of modern quantum theory and information theory.

One hypothesis, put forward by I. M. Kogan of the USSR, is that information transfer under conditions of sensory shielding is mediated by extremely low-frequency (ELF) electromagnetic waves in the 300–1000-km region [37]–[40]. Experimental support for the hypothesis is claimed on the basis of slower than inverse square attenuation, compatible with source-percipient distances lying in the induction field range as opposed to the radiation field range; observed low bit rates (0.005–0.1 bit/s) compatible with the information carrying capacity of ELF waves; apparent ineffectiveness of ordinary electromagnetic shielding as an attenuator; and standard antenna calculations entailing biologically generated currents yielding results compatible with observed signal-to-noise ratios.

M. Persinger, Psychophysiology Laboratory, Laurentian University, Toronto, Canada, has narrowed the ELF hypothesis to the suggestion that the 7.8-Hz "Shumann waves" and their harmonics propagating along the earth–ionosphere waveguide duct may be responsible. Such an hypothesis is compatible with driving by brain-wave currents and leads to certain other hypotheses such as asymmetry between east–west and west–east propagation, preferred experimental times (midnight–4 A.M.), and expected negative correlation between success and the *U* index (a measure of geomagnetic disturbance throughout the world). Persinger claims initial support for these factors on the basis of a literature search [63], [64].

On the negative side with regard to a straightforward ELF interpretation as a blanket hypothesis are the following: a) apparent real-time descriptions of remote activities in sufficient detail to require a channel capacity in all probability greater than that allowed by a conventional modulation of an ELF signal; b) lack of a proposed mechanism for coding and decoding the information onto the proposed ELF carrier; and c) apparent precognition data. The hypothesis must nonetheless remain open at this stage of research, since it is conceivable that counterindication a) may eventually be circumvented on the basis that the apparent high bit rate results from a mixture of low bit rate input and high bit rate "filling in the blanks" from imagination; counterindication b) is common to a number of normal perceptual tasks and may therefore simply reflect a lack of sophistication on our part with regard to perceptual functioning [65]; and counterindication c) may be accommodated by an ELF hypothesis if advanced waves as well as retarded waves are admitted [66], [67]. Experimentation to determine whether the ELF hypothesis is viable can be carried out by the use of ELF sources as targets, by the study of parametric dependence on propagational directions and diurnal timing, and by the exploration of interference effects caused by creation of a high-intensity ELF environment during experimentation, all of which are under consideration in our laboratory and elsewhere.

Some physicists believe that the reconciliation of observed paranormal functioning with modern theory may take place at a more fundamental level—namely, at the level of the foundations of quantum theory. There is a continuing dialog, for example, on the proper interpretation of the effect of an observer (consciousness) on experimental measurement [68], and there is considerable current interest in the implications for our notions of ordering in time and space brought on by the observation [69], [70] of nonlocal correlation or "quantum interconnectedness" (to use Bohm's term [71]) of distant parts of quantum systems of macroscopic dimensions. The latter, Bell's theorem [72], emphasizes that "no theory of reality compatible with quantum theory can require spatially separated events to be independent" [73], but must permit interconnectedness of distant events in a manner that is contrary to ordinary experience [74]–[75]. This prediction has been experimentally tested and confirmed in the recent experiments of, for example, Freedman and Clauser [69], [70].

E. H. Walker and O. Costa de Beauregard, independently proposing theories of paranormal functioning based on quantum concepts, argue that observer effects open the door to the possibility of nontrivial coupling between consciousness and the environment and that the nonlocality principle permits such coupling to transcend spatial and temporal barriers [76], [77].

Apparent "time reversibility"—that is, effects (e.g., observations) apparently preceding causes (e.g., events)—though conceptually difficult at first glance, may be the easiest of apparent paranormal phenomena to assimilate within the current theoretical structure of our world view. In addition to the familiar retarded potential solutions $f(t - r/c)$, it is well known that the equations of, for example, the electromagnetic field admit of advanced potential solutions $f(t + r/c)$—solutions that would appear to imply a reversal of cause and effect. Such solutions are conventionally discarded as not corresponding to any observable physical event. One is cautioned, however, by statements such as that of Stratton in his basic text on electromagnetic theory [78]:

[5] As usually understood.

> The reader has doubtless noted that the choice of the function $f(t - r/c)$ is highly arbitrary, since the field equation admits also a solution $f(t + r/c)$. This function leads obviously to an advanced time, implying that the field can be observed before it has been generated by the source. The familiar chain of cause and effect is thus reversed and this alternative solution might be discarded as logically inconceivable. However, the application of "logical" causality principles offers very insecure footing in matters such as these and we shall do better to restrict the theory to retarded action solely on the grounds that this solution alone conforms to the present physical data.

Such caution is justified by the example in the early 1920's of Dirac's development of the mathematical description of the relativistic electron that also yielded a pair of solutions, one of which was discarded as inapplicable until the discovery of the positron in 1932.

In an analysis by O. Costa de Beauregard, an argument is put forward that advanced potentials constitute a convergence toward "finality" in a manner symmetrical to the divergence of retarded potentials as a result of causality [77]. Such phenomena are generally unobservable, however, on the gross macroscopic scale for statistical reasons. This is codified in the thermodynamic concept that for an isolated system entropy (disorder) on the average increases. It is just this requirement of isolation, however, that has been weakened by the observer problem in quantum theory, and O. Costa de Beauregard argues that the finality principle is maximally operative in just those situations where the intrusion of consciousness as an ordering phenomenon results in a significant local reversal of entropy increase. At this point, further discussion of the subtleties of such considerations, though apropos, would take us far afield, so we simply note that such advanced waves, if detected, could in certain cases constitute a carrier of information precognitive to the event.

The above arguments are not intended to indicate that the precise nature of the information channel coupling remote events and human perception is understood. Rather, we intend to show only that modern theory is not without resources that can be brought to bear on the problems at hand, and we expect that these problems will, with further work, continue to yield to analysis and specification.

Furthermore, independent of the mechanisms that may be involved in remote sensing, observation of the phenomenon implies the existence of an information channel in the information-theoretic sense. Since such channels are amenable to analysis on the basis of communication theory techniques, as indicated earlier, channel characteristics such as bit rate can be determined independent of a well-defined physical channel model in the sense that thermodynamic concepts can be applied to the analysis of systems independent of underlying mechanisms. Furthermore, as we have seen from the work of Ryzl discussed in Section II, it is possible to use such a channel for error-free transmission of information if redundancy coding is used. (See also Appendix A.) Therefore, experimentation involving the collection of data under specified conditions permits headway to be made despite the formidable work that needs to be done to clarify the underlying bases of the phenomena.

VI. Conclusion

For the past three years we have had a program in the Electronics and Bioengineering Laboratory of SRI to investigate those facets of human perception that appear to fall outside the range of well-understood perceptual or processing capabilities. The primary achievement of this program has been the elicitation of high-quality "remote viewing"—the ability of both experienced subjects and inexperienced volunteers to view, by means of innate mental processes, remote geographical or technical targets such as roads, buildings, and laboratory apparatus. Our accumulated data from over fifty experiments with more than a half-dozen subjects indicate the following. a) The phenomenon is not a sensitive function of distance over a range of several kilometers. b) Faraday cage shielding does not appear to degrade the quality or accuracy of perception. c) Most of the correct information that subjects relate is of a nonanalytic nature pertaining to shape, form, color, and material rather than to function or name. (This aspect suggests a hypothesis that information transmission under conditions of sensory shielding may be mediated primarily by the brain's right hemisphere.) d) The principal difference between experienced subjects and inexperienced volunteers is *not* that the latter never exhibit the faculty, but rather that their results are simply less reliable. (This observation suggests the hypothesis that remote viewing may be a latent and widely distributed, though repressed, perceptual ability.)

Although the precise nature of the information channel coupling remote events and human perception is not yet understood, certain concepts in information theory, quantum theory, and neurophysiological research appear to bear directly on the issue. As a result, the working assumption among researchers in the field is that the phenomenon of interest is consistent with modern scientific thought, and can therefore be expected to yield to the scientific method. Further, it is recognized that communication theory provides powerful techniques, such as the use of redundancy coding to improve signal-to-noise ratio, which can be employed to pursue special-purpose application of the remote-sensing channel independent of an understanding of the underlying mechanisms. We therefore consider it important to continue data collection and to encourage others to do likewise; investigations such as those reported here need replication and extension under as wide a variety of rigorously controlled conditions as possible.

Appendix A

Signal Enhancement in a Paranormal Communication Channel by Application of Redundancy Coding

Independent of the mechanisms that may be involved in remote sensing, observation of the phenomenon implies the existence of an information channel in the information-theoretic sense. As we have seen from the work of Ryzl discussed in Section II,[6] it is even possible to use such a (noisy) channel for error-free transmission of information if sufficient redundancy coding is used [30], [31]. Following is a general procedure that we have used successfully for signal enhancement.

We shall assume that the "message" consists of a stream of binary digits (0,1) of equal probability (e.g., binary sort of green/white cards as in Ryzl's case, English text encoded as in Table X and sent long distance by strobe light on/off, and so on). To combat channel noise, each binary digit to be sent through the channel requires the addition of redundancy bits (coding). Efficient coding requires a compromise between the desire to maximize reliability and the desire to minimize re-

[6] See also the note added in proof on the successful work done by Carpenter.

TABLE X
5-BIT CODE FOR ALPHANUMERIC CHARACTERS

E	00000	Y	01000
T	11111	G,J	10111
N	00001	W	01001
R	11110	V	10110
I	00010	B	01010
O	11101	Ø	10101
A	00011	1	01011
S,X,Z	11100	2	10100
D	00100	3	01100
H	11011	4	10011
L	00101	5	01101
C,K,Q	11010	6	10010
F	00110	7	01110
P	11001	8	10001
U	00111	9	01111
M	11000	.	10000

Note: Alphabet characters listed in order of decreasing frequency in English text. See, for example, A. Sinkov [79]. (The low-frequency letters, X, Z, K, Q, and J, have been grouped with similar characters to provide space for numerics in a 5-bit code.) In consideration of the uneven distribution of letter frequencies in English text, this code is chosen such that 0 and 1 have equal probability.

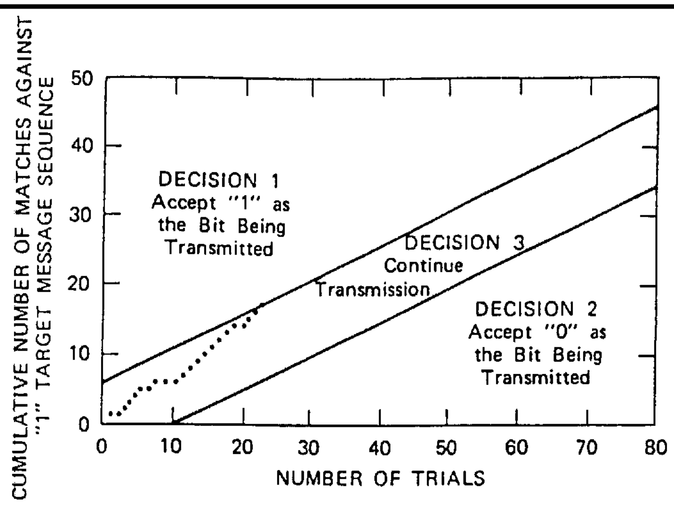


Fig. 18. Enhancement of signal-to-noise ratio by sequential sampling procedure ($p_0 = 0.4, p_1 = 0.6, \alpha = 0.01, \beta = 0.01$).

dundancy. One efficient coding scheme for such a channel is obtained by application of a sequential sampling procedure of the type used in production-line quality control [80]. The adaptation of such a procedure to paranormal communication channels, which we now discuss, was considered first by Taetzsch [81]. The sequential method gives a rule of procedure for making one of three possible decisions following the receipt of each bit: accept 1 as the bit being transmitted; reject 1 as the bit being transmitted (i.e., accept 0); or continue transmission of the bit under consideration. The sequential sampling procedure differs from fixed-length coding in that the number of bits required to reach a final decision on a message bit is not fixed before transmission, but depends on the results accumulated with each transmission. The principal advantage of the sequential sampling procedure as compared with the other methods is that, on the average, fewer bits per final decision are required for an equivalent degree of reliability.

Use of the sequential sampling procedure requires the specification of parameters that are determined on the basis of the following considerations. Assume that a message bit (0 or 1) is being transmitted. In the absence of *a priori* knowledge, we may assume equal probability ($p = 0.5$) for the two possibilities (0,1). Therefore, from the standpoint of the receiver, the probability of correctly identifying the bit being transmitted is $p = 0.5$ because of chance alone. An operative remote-sensing channel could then be expected to alter the probability of correct identification to a value $p = 0.5 + \psi$, where the parameter ψ satisfies $0 < |\psi| < 0.5$. (The quantity may be positive or negative depending on whether the paranormal channel results in so-called psi-hitting or psi-missing.) Good psi functioning on a repetitive task has been observed to result in $\psi = 0.12$, as reported by Ryzl [31]. Therefore, to indicate the design procedure, we assume a baseline parameter $\psi_b = 0.1$ and design a communication system on this basis.

The question to be addressed is whether, after repeated transmission, a given message bit is labeled a "1" at a low rate p_0 commensurate with the hypothesis H_0 that the bit in question is a "0," or at a higher rate p_1 commensurate with the hypothesis H_1 that the bit in question is indeed a "1." The decision-making process requires the specification of four parameters.

- p_0 The probability of labeling incorrectly a "0" message bit as a "1." The probability of labeling correctly a "0" as a "0" is $p = 0.5 + \psi_b = 0.6$. Therefore, the probability of labeling incorrectly a "0" as a "1" is $1 - p = 0.4 = p_0$.
- p_1 The probability of labeling correctly a "1" message bit as a "1," is given by $p_1 = 0.5 + \psi_b = 0.6$.
- α The probability of rejecting a correct identification for a "0" (Type I error). We shall take $\alpha = 0.01$.
- β The probability of accepting an incorrect identification for a "1" (Type II error). We shall take $\beta = 0.01$.

With the parameters thus specified, the sequential sampling procedure provides for construction of a decision graph as shown in Fig. 18. The equations for the upper and lower limit lines are

$$\sum_1 = d_1 + SN$$

$$\sum_0 = -d_0 + SN$$

where

$$d_1 = \frac{\log \frac{1-\beta}{\alpha}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}} \qquad d_0 = \frac{\log \frac{1-\alpha}{\beta}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}}$$

$$S = \frac{\log \frac{1-p_0}{1-p_1}}{\log \frac{p_1}{p_0} \frac{1-p_0}{1-p_1}}$$

in which S is the slope, N is the number of trials, and d_1 and d_0 are the y-axis intercepts. A cumulative record of receiver-generated responses to the target bit is compiled until either

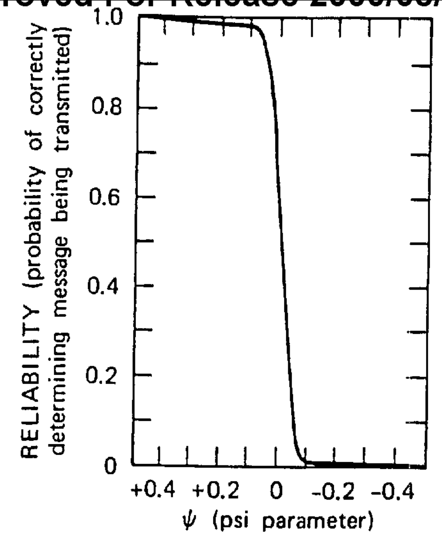


Fig. 19. Reliability curve for sequential sampling procedure ($p_0 = 0.4$, $p_1 = 0.6$, $\alpha = 0.01$, $\beta = 0.01$).

the upper or the lower limit line is reached, at which point a decision is made to accept 0 or 1 as the bit being transmitted.

Channel reliability (probability of correctly determining message being transmitted) as a function of operative psi parameter ψ is plotted in Fig. 19. As observed, the sequential sampling procedure can result in 90 percent or greater reliability with psi parameters on the order of a few percent.

Implementation of the sequential sampling procedure requires the transmission of a message coded in binary digits. Therefore, the target space must consist of dichotomous elements such as the white and green cards used in the experiments by Ryzl.

In operation, a sequence corresponding to the target bit (0 or 1) is sent and the cumulative entries are made (Fig. 18) until a decision is reached to accept either a 1 or a 0 as the bit being transmitted. At a prearranged time, the next sequence is begun and continues as above until the entire message has been received. A useful alternative, which relieves the percipient of the burden of being aware of his self-contradiction from trial to trial, consists of cycling through the entire message repetitively and entering each response on its associated graph until a decision has been reached on all message bits. The authors have used this technique successfully in a pilot study, but a discussion of this would take us beyond the intended scope of this paper.

From the results obtained in such experiments, the channel bit rate can be ascertained for the system configuration under consideration. Furthermore, bit rates for other degrees of reliability (i.e., for other p_0, p_1, α, and β) can be estimated by construction of other decision curves over the same data base and thus provide a measure of the bit rate per degree of reliability.

In summary, the procedures described here can provide for a specification of the characteristics of a remote-sensing channel under well-defined conditions. These procedures also provide for a determination of the feasibility of such a channel for particular applications.

Appendix B

Remote-Viewing Transcript

Following is the unedited transcript of the *first* experiment with an SRI volunteer (S6), a mathematician in the computer science laboratory, with no previous experience in remote viewing. The target, determined by random procedure, was White's Plaza, a plaza with fountain at Stanford University (shown in Fig. 8). As is our standard protocol, the experimenter with the subject is kept ignorant of the specific target visited as well as the contents of the target pool. The experimenter's statements and questions are italics.

Today is Monday, October 7th. It is 11:00 and this is a remote viewing experiment with Russ Targ, Phyllis Cole, and Hal Puthoff. In this experiment Hal will drive to a remote site chosen by a random process. Phyllis Cole will be the remote viewer, and Russ Targ is the monitor. We expect this experiment to start at twenty minutes after eleven and run for fifteen minutes.

It is just about twenty minutes after eleven and Hal should be at his target location by now.

Why don't you tell me what kind of pictures you see and what you think he might be doing or experiencing.

The first thing that came to mind was some sort of a large, square kind of a shape. Like Hal was in front of it. It was a . . . not a building or something, it was a square. I don't know if it was a window, but something like that so that the bottom line of it was not at the ground. About where his waist was, at least. That's what it seemed to me. It seems outdoors somehow. Tree.

Does Hal seem to be looking at that square?

I don't know. The first impression was that he wasn't, but I have a sense that whatever it was was something one might look at. I don't know if it would be a sign, but something that one might look at.

Can you tell if it is on the ground or vertical?

It seemed vertical.

I don't have a sense that it was part of anything particular. It might be on a building or part of a building, but I don't know. There was a tree outside, but I also got the impression of cement. I don't have the impression of very many people or traffic either. I have the sense that he is sort of walking back and forth. I don't have any more explicit picture than that.

Can you move into where he is standing and try to see what he is looking at?

I picked up he was touching something—something rough. Maybe warm and rough. Something possibly like cement.

It is twenty-four minutes after eleven.

Can you change your point of view and move above the scene so you can get a bigger picture of what's there?

I still see some trees and some sort of pavement or something like that. Might be a courtyard. The thing that came to mind was it might be one of the plazas at Stanford campus or something like that, cement.

Some kinds of landscaping.

I said Stanford campus when I started to see some things in White Plaza, but I think that is misleading.

I have the sense that he's not moving around too much. That it's in a small area.

I guess I'll go ahead and say it, but I'm afraid I'm just putting on my impressions from Stanford campus. I had the impression of a fountain. There are two in the plaza, and it seemed that Hal was possibly near the, what they call Mem Claw.

What is that?

It's a fountain that looks rather like a claw. It's a black sculpture. And it has benches around it made of cement.

Are there any buildings at the place you are looking at? Are there any buildings? You described a kind of a courtyard.

Usually at some places there should be a building, large or small that the courtyard is about. Look at the end or the sides of the courtyard. Is there anything to be seen?

I have a sense that there are buildings. It's not solid buildings. I mean there are some around the periphery and I have a sense that none of them are very tall. Maybe mostly one story, maybe an occasional two story one.

Do you have any better idea of what your square was that you saw at the outset?

No. I could hazard different kinds of guesses.

Does it seem part of this scene?

It . . . I think it could be. It could almost be a bulletin board or something with notices on it maybe.

Or something that people are expected to look at. Maybe a window with things in it that people were expected to look at.

What kind of trees do you see in this place?

I don't know what kind they are. The impression was that they were shade trees and not terribly big. Maybe 12 feet of trunk and then a certain amount of branches above that. So that the branches have maybe a 12 foot diameter, or something. Not real big trees.

New trees rather than old trees?

Yeah, maybe 5 or 10 years old, but not real old ones.

Is there anything interesting about the pavement?

No. It seems to be not terribly new or terribly old. Not very interesting. There seems to be some bits of landscaping around. Little patches of grass around the edges and peripheries. Maybe some flowers. But, not lush.

You saw some benches. Do you want to tell me about them?

Well, that's my unsure feeling about this fountain. There was some kind of benches of cement. Curved benches, it felt like.

They were of rough cement.

What do you think Hal is doing while he is there?

I have a sense that he is looking at things trying to project them. Looking at different things and sort of walking back and forth not covering a whole lot of territory.

Sometimes standing still while he looks around.

I just had the impression of him talking, and I almost sense that it was being recorded or something. I don't know if he has a tape recorder, but if it's not that, then he is saying something because it needed to be remembered. *It's 11:33. He's just probably getting ready to come back.*

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ADVANCES IN REMOTE-VIEWING ANALYSIS

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ABSTRACT: Fuzzy set technology is applied to the ongoing research question of how to automate the analysis of remote-viewing data. Fuzzy sets were invented to describe, in a formal way, the subjectivity inherent in human reasoning. Applied to remote-viewing analysis, the technique involves a quantitative encoding of target and response material and provides a formal comparison. In this progress report, the accuracy of a response is defined as the percent of the intended target material that is described correctly. The reliability is defined as the percent of the response that was correct. The assessment of the remote-viewing quality is defined as the product of accuracy and reliability, called the figure of merit. The procedure is applied to a test set of six remote-viewing trials. A comparison of the figures of merit with the subjective assessments of 37 independent analysts shows good agreement. The fuzzy set technology is also used to provide a quantitative definition of target orthogonality.

Human analysts are commonly used to evaluate free-response data. Although there are many variations, the basic idea is that an analyst, who is blind to the actual result, is presented with a response and a number of target possibilities, one of which is the intended target. The analyst's task is to decide what is the best response/target match, and frequently includes rank-ordering the targets from best to worst correspondence with the response. It is beyond the scope of this report to provide a critical review of the extensive literature on this topic.

One aspect, however, of this type of evaluation is that analysts are required to make global judgments about the overall match between a complex target (e.g., a photograph of a natural scene) and an equally complex response (e.g., written words and drawings). In a recent book, Dawes (1988) has discussed various decision algorithms in general and the difficulty with global techniques, such as those used in rank-order evaluation, in particular.[1] According to Dawes, the research results suggest that global decisions of this type are not as good as those based on smaller subelements that are later

[1] We are indebted to Professor D. Bem, Cornell University, for directing us to this valuable source of information.

combined. (See Dawes, 1988, chap. 10, for references to the research.) Humans appear to be capable of deciding what the appropriate variables should be in complex decision processes, but they have proved to be unreliable at combining these variables to arrive at a single decision. Linear algorithms are consistently better at this latter task. Therefore, it seems prudent to develop evaluation techniques that are less sensitive to global decision processes and rely on combinations of more restrictive decisions.

Honorton (1975) has pointed out an additional difficulty inherent in a global rank-order approach. Asking an analyst to rank-order a small set of target possibilities converts the free-response experiment into a forced-choice one, at least on the part of the analyst. It is obvious that in doing so, much quantitative information is lost. For example, a near perfect correspondence between response and target will receive only as much "credit" as one that just barely allowed an analyst to discriminate among the possibilities.

If multiple analysts are used, addition problems arise concerning interanalyst reliability. If an individual analyst judges a number of responses in a series, within-analyst consistency becomes an individual problem.

To address these difficulties, various computer-automated procedures have been suggested in an attempt to reduce the interanalyst reliability while increasing within-analyst consistency. For examples, see Honorton (1975), Humphrey, May, Trask, and Thomson (1986), Humphrey, May, and Utts (1988), Jahn, Dunne, and Jahn (1980), May (1983), May, Humphrey, and Mathews (1985), and Targ, Puthoff, and May (1977).

In this paper we present the current status of an ongoing research topic. We are not yet ready to propose that the techniques described here be used for free-response analysis; however, we hope to inspire the community to develop a proper set of subvariables so that the problems inherent in global decision processes can be avoided.

Finally, we present a successful application of the mathematical techniques for quantifying target orthogonality for a complex target pool.

Background

Substantial progress has been made in methods for evaluating remote-viewing experiments since the publication of the initial remote-viewing (RV) effort at SRI International (Puthoff & Targ, 1976). This paper outlines some of the progress and presents the details for one particular method.[2]

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Two basic questions are inherent in the analysis of any remote-viewing data, namely, how is the target defined, and how is the response defined.

In a typical outbound RV experiment, definitions of *target* and *response* are particularly difficult to achieve. The protocol for such an experiment dictates that an experimenter travel to some randomly chosen location at a prearranged time; a viewer's task is to describe that location. One method of trying to assess the quality of the RV descriptions in a series of trials is to require that an analyst visit each of the sites and attempt to match responses to them. While standing at a site, the analyst has to determine not only the bounds of the site, but also the site details that are to be included in the analysis. For example, if the target location was the Golden Gate Bridge, the analyst would have to determine whether the buildings of downtown San Francisco, which are clearly and prominently visible from the bridge, were to be considered part of the target. The RV response to the Golden Gate Bridge target could be equally troublesome, because responses of this sort are typically 15 pages of dream-like free associations. A reasonable description of the bridge might be contained in the response; it might be obfuscated, however, by a large amount of unrelated material. How is an analyst to approach this problem of response definition?

The first attempt at SRI at quantitatively defining an RV response involved reducing the raw transcript to a series of declarative statements called concepts (Targ et al., 1977). Initially, it was decided that a coherent concept should not be reduced to its component parts. For example, a *small red VW car* would be considered a single concept rather than four separate concepts, *small, red, VW,* and *car*. Once a transcript had been "conceptualized," the list of concepts constituted, by definition, the RV response. The analyst rated the concept lists against the sites. Although the response was well defined by this method, no attempt was made to define the target site.

In 1982, a procedure was developed to define both the target and response material (May, 1983). It became evident that before a site can be qualified, the overall remote-viewing goal must be clearly defined. If the goal is simply to demonstrate the existence of the

[2] Although the term *remote viewing* is used throughout this paper, the analysis techniques can easily be applied to any free-response data.

RV phenomenon, then anything that is perceived at the site is important. But if the goal is to gain specific information about the RV process, then possibly specific items at the site are important whereas others remain insignificant.

In 1984, work began on a computerized evaluation procedure (May et al., 1985), which underwent significant expansion and refinement during 1986 (Humphrey et al., 1986). The mathematical formalism underlying this procedure is known as the "figure of merit" (FM) analysis. This method is predicated on descriptor list technology, which represented a significant improvement over earlier "conceptual analysis" techniques, both in terms of "objectifying" the analysis of RV data and in increasing the speed and efficiency with which evaluation can be accomplished. Humphrey's technique, which was based on the pioneering work of Honorton (1975) and its expansion by Jahn, Dunne, and Jahn (1980), was to encode target and response material in accordance with the presence or absence of specific elements.

It became increasingly evident, however, that this particular application of descriptor lists was inadequate in providing discriminators that were "fine" enough to describe a complex target accurately, and unable to exploit fully the more subtle or abstract information content of the RV response. To decrease the granularity of the RV evaluation system, therefore, a new technology would have to allow the analyst a gradation of judgment about target and response features rather than the hard-edged (and rather imprecise) all-or-nothing binary determinations. Requiring an analyst to restrict subjective judgment to single elements rather than to complete responses is consistent with the research reported by Dawes (1988).

A preliminary survey of various disciplines and their evaluation methods (spanning such diverse fields as artificial intelligence, linguistics, and environmental psychology) revealed a branch of mathematics known as "fuzzy set theory."[3]

Fuzzy Set Concepts

Fuzzy set theory was chosen as the focal point of the RV analytical techniques because it provides a mathematical framework for modeling situations that are inherently imprecise. Because it is such an important component in the analysis, a brief tutorial will be presented to highlight its major concepts.

[3] We wish to thank S. James P. Spottiswoode and D. Graff, CE, for directing us to the fuzzy set literature and for many helpful discussions.

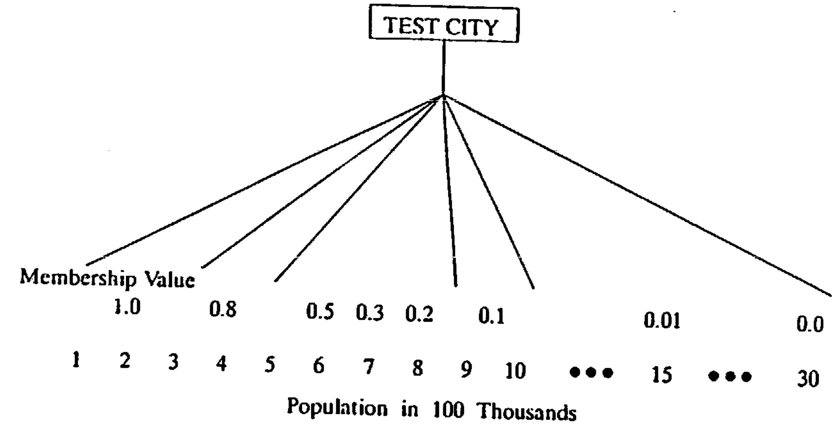

Figure 1. The fuzzy set "kind-of-small" cities.

In traditional set theory (i.e., crisp sets), an element either is or is not a member of a set. For example, the crisp set of cities with population equal to or greater than 1,000,000 includes New York City, but not San Francisco. This set would also *not* include a city with a population of 999,999. The problem is obvious. There is no real difference between cities with populations of 1,000,000 and 999,999, yet one is in the set and the other is not. Humans do not reason this way; therefore, something other than crisp sets is required to capture the subjectivity inherent in RV analysis.

Fuzzy set theory introduces the concept of *degree* of membership. Herein lies the essence of its applicability to the modeling of imprecise concepts. For example, if we consider the size of a city, we might define certain *fuzzy sets*, such as *very small* cities or *kind-of-small* cities. Using *kind-of-small* cities as a fuzzy set example, we might subjectively assert that a city with a population of 100,000 is definitely such a city, but a city with a population of 400,000 is only a little bit like a *kind-of-small* city. As depicted in Figure 1, fuzzy set theory allows us to assign a membership value between 0 and 1 that represents our best subjective estimate as to how much each of the possible city populations embodies the concept *kind-of-small*. In this example, a population of 700,000 assigned a membership value of 0.3.

Clearly, a different set of membership values would be assigned to the populations for the fuzzy sets *very small* cities, *medium* cities, *large* cities, and so forth; a population of 100,000 might receive a value of 0.2 for very small cities, but a value for 1.0 for kind-of-small cities, depending on context, consensus, and the particular application. These membership values can be obtained through consensus opinion, a mathematical formula, or by several other means. Crisp sets are special cases of fuzzy sets, in which all membership values are either zero or one. By using membership values, we are able to provide manipulatable numerical values for imprecise natural-language expressions; in addition, we are no longer forced into making inaccurate binary decisions such as, "Is the city of San Francisco large—yes or no?"

In this example, the crisp set of all cities defines the universal set of elements (USE). The crisp set of cities with populations of one million or more is a subset of USE. The fuzzy sets *very small*, *kind-of-small*, *medium*, and *large* cities are fuzzy subsets of USE.

Universal Set of Elements

Since targets and the responses will be defined as fuzzy sets, we must specify a USE. The universal set of elements can be quite general and include all aspects of a given target pool, or it can be tailored to a specific experiment to test a given concept (e.g., include only geometric shapes). Since the method of fuzzy set analysis critically depends on the choice of USE, we provide one example that was derived from a target pool used in earlier experiments. What follows is *only* an example of how one might construct a USE. The one we use is not generally applicable to other target pools or other experiments.

We constructed our USE by including a list of features present in photographs from the *National Geographic* magazine with elements obtained from the RV responses in earlier experiments. This USE is presented in Appendix A as the actual coding forms. For the target features, we focused on direct visual elements. (In the general case, other perceptual dimensions can be considered.) In the case of the RV response-derived elements, an effort was made to preserve the vocabulary used by the viewers. Some of the elements, therefore, are either response-dependent or target-dependent or both, whereas others, particularly at the more abstract levels appear to be more universal across possible USEs.

This universal set of elements is structured in *levels*, ranging from the relatively abstract, information poor (such as vertical lines), to the relatively complex, information rich (such as churches). The current system is structured into seven primary and three secondary levels of elements; the main intent of this structure is to serve as a heuristic device for guiding the analyst into making judicious concrete element assignments based on rather abstract commentary. The use of levels is advantageous in that each element level can be weighted separately and used or not, as the case may be. This enables various combinations of levels to be deployed to identify the optimal mix of concrete versus abstract elements. Of course, any such weighting scheme must be determined in advance of any experiment.

The determination as to which elements belonged on which level was made after consideration of two primary factors: (1) the apparent ability of the viewers to be able to resolve certain features, coupled with (2) the amount of pure information thought to be contained in any given element. Some of these "factor one" determinations were based on the combined anecdotal experience of analysts and monitors in the course of either analyzing or conducting numerous RV experiments; some were determined empirically from post hoc analyses of viewers' abilities to perceive various elements in previous experiments.

The "factor two" determinations were made primarily by arranging the elements such that an element at any given level represents the sum of its constituent elements at lower levels. For example, a *port* element (Level 7) could be considered to include *canal* (Level 6) and *partially bounded expanse of water* (Level 5). The world is not a very crisp place and not all its elements are amenable to hierarchical structuring. Certain violations of the "factor two" rule appear, therefore, throughout the USE example. It should be noted, however, that some of the more glaring violations were largely driven by the "factor one" determinations (i.e., the viewers' abilities to discern certain elements) enumerated above.

To emphasize once again, it is very important to realize that this universal set of elements was constructed to match our particular special targets, viewers, and requirements. They are shown here to illustrate the procedure. Any particular application of fuzzy set technology to the analysis of free-response material requires an a priori construction of an individualized, and improved, USE specific to the target pool and the goals of the experiment.

Target Fuzzy Sets

Each target is defined as a fuzzy set constructed by assigning a membership value to each of the elements in the USE (see Appendix A). In general, membership values can vary continuously on the interval [0,1]. In this application they represent human judgment

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and, thus, were constrained to vary in steps of 0.1. In addition, they must represent the perceptual dimension used to construct the USE. In our example, membership values were assigned to each element for each of the targets, according to a consensus (on an element-by-element basis) reached by three analysts. This approach was used to mitigate the potential influence of any single coder's biases and idiosyncrasies. A numerical assignment, μ ($0 \leq \mu \leq 1$, in steps of 0.1), was made for each element in response to the following question: How visually important is this element to this photograph?

Encoded by this method, the fuzzy sets served as a formal definition of the targets for the analysis. It should be noted that our USE defined targets in terms of visual importance.[4] If other dimensions are of interest (e.g., conceptual, functional, allegorical), the USE would have to be revised to incorporate them.

In an actual experimental series, it is critical that the target fuzzy sets be defined by analysts *before* the series begins. Because of the potential information leakage owing to bias on the part of the analyst, it is an obvious mistake to attempt to define the target fuzzy set on a target-by-target basis in real time or post hoc.

Response Fuzzy Sets

To define RV response fuzzy sets, membership values μ are assigned for each element in the USE by asking: To what degree am I (the analyst) convinced that this element is represented in this response? For example, if a response explicitly states "water," then the membership value for the water-element should be 1. If, however, the response is a rough sketch of what might be waves, then the membership value for the water-element might be only 0.3, depending on the specificity of the drawing. This definition of membership value is quite general and can be used in most applications.

In our example, responses were coded according to this definition (but still using the USE in Appendix A). The assigned μ's for the targets and responses were one-digit fuzzy numbers on the interval [0,1] (e.g., 0.1, 0.2, 0.3, etc.). In some rare cases, two-digit assignments (e.g., 0.05, 0.15, 0.25, 0.35, etc.) were made; any finer assignments, however, were deemed to be meaningless. Thus, the response was defined as its fuzzy subset of the USE.

[4] Implied visual importance was ignored. For example, in a photograph of the Grand Canyon that did not show the Colorado River, water, river, and so on would be scored as zero. By definition the target was only what was visible in the photograph.

In an actual experimental series, each response fuzzy set is created by analysts who are blind to the intended target.

Fuzzy Set Definition of Figure of Merit

Once the fuzzy sets that define the target and the response have been specified, the comparison between them to provide a figure of merit (FM) is straightforward. In previous work (Humphrey et al., 1986), we have defined *accuracy* as the percent of the target material that was described correctly by a response. Likewise, we have defined *reliability* (of the viewer) as the percent of the response that was correct. The FM is the product of the two; to obtain a high FM, a response must be a comprehensive description of the target and be devoid of inaccuracies. The mathematical definitions for accuracy and reliability for the jth target/response pair are as follows. Let $\mu_k(R_i)$ and $\mu_k(T_j)$ be the membership values for the kth element in USE for the ith response and the jth target, respectively. Then the accuracy and reliability for the ith response applied to the jth target are given by:

$$\text{accuracy}_{ij} = a_{ij} = \frac{\sum_k W_k \min\{\mu_k(R_i), \mu_k(T_j)\}}{\sum_k W_k \mu_k(T_j)},$$

$$\text{reliability}_{ij} = r_{ij} = \frac{\sum_k W_k \min\{\mu_k(R_i), \mu_k(T_j)\}}{\sum_k W_k \mu_k(R_i)}$$

where the sum over k is called the *sigma count* in fuzzy set terminology, and is defined as the sum of the membership values. We have allowed for the possibility of weighting the membership values with weights W_k in order to examine various level/element contributions to the FM. The index, k, ranges over the entire USE.

For the above calculation to be meaningful, the μ's for the targets must be similar in meaning to the μ's for the responses. As we noted above, in our definition of the membership values, this is not the case. The target μ's represent the visual importance of the element relative to the scene, and the response μ's represent the degree to which an analyst is convinced that the element is represented in the response regardless of its relevance to that response.

With advanced viewers it might be possible to change the definition of the response μ's to match the definition of the target μ's. In that case, the viewer must not only recognize that an element is present in the target, but must also provide information as to how visually important it is. This ability is currently beyond the skill of most novice viewers. Alternatively, we have opted to modify the target μ definition by using the fuzzy set technique of α-cuts. In our example, an α-cut is a way to set a threshold for visual importance. All target elements possessing that threshold value or higher are considered to be full members of the target set. In fuzzy set parlance, an α-cut converts a fuzzy set to a crisp one. The result is that the target set is now devoid of detailed visual information: a potential target element is either present or absent in the target set, regardless of its actual visual importance. Even with this conceptual change in the target definition, the FM formalism described above remains applicable, because a crisp set can be considered as a fuzzy set with all membership values equal to 0 or 1. It is important to recognize that the α-cut is only applied to the target set; the response set remains fuzzy.

Assessment of Quality of the Remote Viewing

It is difficult to arrive at a general assessment of how well a given response matches a specified target. The ideal situation is to obtain some absolute measure of goodness of match. Although the FM is an approximation to this measure, it is impossible to assess the likelihood of a particular FM value because it requires knowledge of the viewer's *specific* response bias for the session. It is possible to determine general response biases (May et al., 1985), but that knowledge is only useful on the average. For example, a viewer may love rock climbing and may spend most of his free time involved in that activity. Thus, the general response bias would probably entail aspects of mountains, rocks, ropes, and so forth. Suppose, however, that the viewer spent the evening previous to a given RV session on a romantic moonlight sail on San Francisco Bay. For this specific RV session, the response bias might include romantic images of the moonlit water, lights of the city, and bridges.

The current solution to the problem is to provide a *relative* assessment of FM likelihood. A relative assessment addresses the following question: "How good is the response matched against its intended target, when compared to all possible targets that could have been chosen for the session?" This is not ideal, since the answer depends on the nature of the remaining targets in the pool. An example of the worst-case scenario illustrates the problem. Suppose that the target pool consisted of 100 photographs of waterfalls, and the viewer gave a near-perfect description of a waterfall. (We assume that this description is not fortuitous.) An absolute assessment of the resulting FM should be good, whereas a relative assessment will be low. The worst-case scenario can be avoided, to a large degree, by carefully selecting the target pool. (See the later section "Quantitative Definition of Target Orthogonality.")

To provide a relative assessment of the likelihood of a given FM, we define the score for one session to be the number of targets, n, out of a total, N, that have an FM equal to or higher than the FM achieved by the correct match.[5] The answer to the question: "Given this response, what is the probability of selecting a target that would match it as well as or better than the target selected?" is n/N.

Consecutive RV responses by the same viewer are not statistically independent, nor can the responses be considered to be random in any sense. The statistically independent random element in the session is the target. Since targets are selected with replacement, under the null hypothesis of no psi, the collection of scores derived over a series of m trials constitutes a set of independent random variables, each with a discrete uniform distribution. Under the null hypothesis, the mean chance expectation for the score in each session is given by $(N + 1)/2$ and the variance is given by $(N^2 - 1)/12$. If K is the sum of scores from a series of remote viewings, then the probability of K, under the null hypothesis, can be obtained from the exact distribution for the sum of ranks given by Solfvin, Kelly, and Burdick (1978):

$$p(K \text{ or less}) = \frac{1}{N^m}\sum_{a=m}^{K}\sum_{b=0}^{N}(-1)^b\binom{m}{b}\binom{a - bN - 1}{m - 1}. \qquad (1)$$

If m is large, then the sum-of-ranks distribution is approximately normal and K/m has a mean of $(N + 1)/2$ and a variance of $(N^2 - 1)/12m$. Thus, a z score can be computed from:

$$z(K \text{ or less}) = \frac{0.5(N + 1) - \frac{K}{m}}{\sqrt{\frac{N^2 - 1}{12m}}}. \qquad (2)$$

[5] N must be the size of the target pool from which each target was randomly selected, and for this theoretical discussion, we assume no ties.

Ground Truth

To determine whether the new analytical approach was effective, a standard had to be developed against which it could be measured. It was determined that this standard—known as "ground truth"—should consist of a "real-world" normalized consensus about the degree of correspondence between RV responses and their intended targets.

To achieve this objective, we presented analysts (chosen from the general SRI staff) with the same test case of six remote-viewing responses and their associated targets. The test case was the data from a single viewer (177) taken from an experimental series in a 1986 photomultiplier tube experiment (Hubbard, May, & Frivold, 1987). The responses (i.e., two to five pages of rudimentary drawings with some associated descriptive words) were fairly typical of novice viewer output and represented a broad range of response quality. The targets consisted of six photographs of outdoor scenes selected from a *National Geographic* magazine target pool of 200. Thus, this data set was ideally suited for an analysis testbed. Appendix B contains the "best" and "worst" trials (Sessions 9005 and 9004, respectively) from this series in the form of their responses, their intended targets, and their fuzzy set encodings (see the next section).

Each analyst was asked individually for his subjective judgment about the degree of correspondence between the remote-viewing responses and their respective intended targets. The "degree of correspondence" was purposely undefined; the analysts had to formulate their own criteria. The only information provided was that responses typically begin with small bits of information and eventually culminate in a composite drawing at the end. Appendix C contains the coding form that was used to obtain "ground truth."

Each analyst was instructed to examine all of the responses and their intended targets. Then, on a session-by-session basis, he was asked (1) to assess the degree of correspondence between the remote-viewing response and its intended target, and (2) to register this correspondence assessment by making a vertical hash mark across a 10-cm scale ranging from "none" to "complete."

To perform the ground truth analysis, distance measurements were taken from the left end point of each scale to the vertical slash mark for each assessment. Let the distance obtained for the kth session from the jth analyst be given by $x_{j,k}$. To account for analysts' biases, the $x_{j,k}$ were normalized by a z transformation,

$$z_{j,k} = \frac{x_{j,k} - \mu_j}{\sigma_j},$$

where μ_j and σ_j are the mean and standard deviation of the jth analyst's distance scores, $x_{j,k}$. The effect of this transformation is to convert an analyst's absolute subjective opinion to a relative one. For the jth analyst, the largest $z_{j,k}$ indicates that the degree of correspondence for response/target k is higher than *any other pair* in the series. It does *not* indicate overall quality. This type of transformation was necessary since we wished to combine the assessments from a number of different analysts.

To combine the assessments across analysts, we computed the mean z score for each response/target pair, k, as:

$$z_k = \frac{1}{N_a} \sum_{j=1}^{N_a} z_{j,k},$$

where N_a is the number of analysts. The number of analysts was determined by the data. For the best response/target pair (i.e., session 9005, $k = 5$) we computed the percent change of z_5 for every additional analyst. When the addition of two new analysts produced consecutive changes of less than 2%, the process was considered complete. For this data set, 37 analysts were required before this condition was met. Figure 2 shows the normalized mean for each target/response pair, and represents a relative assessment of remote-viewing quality. These means constitute the basis for the ground truth against which the fuzzy set technique was measured. We recognize that this definition of ground truth is based on global decisions and may not be most optimal (Dawes, 1988).

Results of the Fuzzy Set Analysis

To effect a meaningful comparison between ground truth and the figure of merit analysis, we also analyzed the same RV series that served as the ground truth set by the fuzzy set figure of merit method. The fuzzy set membership values (μ's) for the six targets and six responses were consensus coded by five analysts ranging from expert to novice. A typical spread of μ assignments was $\pm$ 0.1 with an occasional outlier. Some of the elements were vigorously debated until a consensus was reached. Accuracies, reliabilities, and

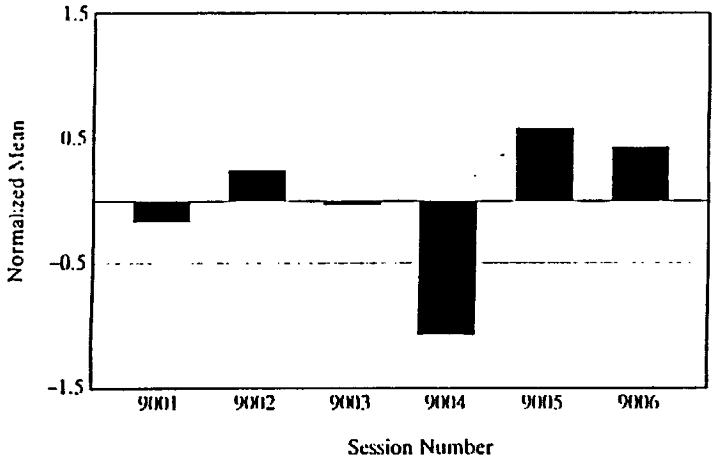

Figure 2. Normalized mean for each target/response pair.

figures of merit were calculated for each target/response pair (Table 1). It should be noted that the encoding was a post hoc exercise, but because the assignment for each element in the USE had to be defended before a consensus was reached, the FMs shown in Table 1 constitute reasonable estimates of their "blind" equivalents. Appendix B shows the target and response elements that were scored from the universal set (see Appendix A) for Sessions 9004 and 9005. As an example of the fuzzy calculation, Appendix B also shows the re-

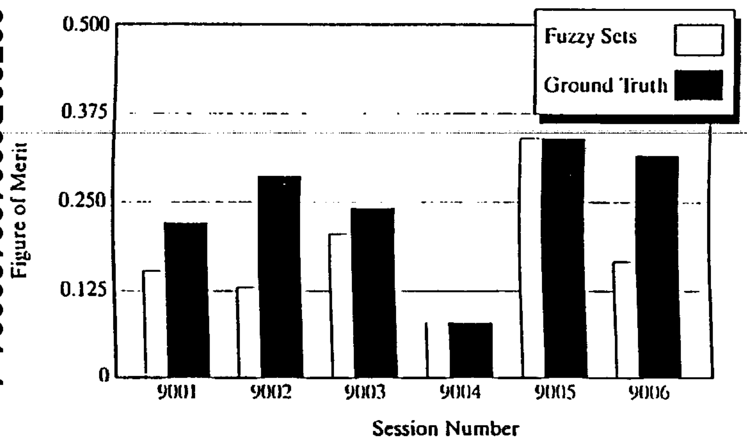

Figure 3. Comparison with ground truth.

TABLE 1
FUZZY SET QUANTITIES FOR "GROUND TRUTH" SERIES

Session	Accuracy	Reliability	Figure of merit	Rank	Fractional rank
9001	.317	.484	.153	80	.403
9002	.273	.477	.130	103	.515
9003	.358	.571	.205	31	.155
9004	.212	.379	.080	142	.713
9005	.573	.594	.340	3	.015
9006	.298	.555	.165	13	.068

sults of the target α-cut, the fuzzy intersection, and the accuracy, reliability, and figure of merit for Session 9005. Table 1 also shows the absolute and relative ranks from a target pool of 200. To determine the absolute rank for each session, we calculated figures of merit for all 200 targets in the pool and placed them in numeric order from the largest to the smallest. The absolute rank is just the position (from the top) of the FM corresponding to the intended target. Ties were resolved by choosing the next larger integer rank number to the centroid of the ties. The fractional rank number can be considered a p value for an individual session and is equal to the absolute rank/200. Using Equation 1, the overall p value for the combined six trials is .052 ($N = 200$, $K = 372$, $m = 6$). Using the approximation (Equation 2), we compute $z = 1.633$, $p \leqslant .05$, to demonstrate that for six trials, the approximation in reasonable. For completeness, we compute the effect size ($r = 0.67$).

To compare the results of the fuzzy set analysis with those of the ground truth, we linearly renormalized the ground truth figures to be within the interval [0,1] and to possess the same maximum and minimum. As can be seen from Figure 3, the results from the fuzzy set analysis system parallel those obtained by a consensus of the 3 analysts each making a subjective assessment of the matches.

These results imply that the combination of (1) the structure of the USE (i.e., the linguistic hierarchical structure), (2) the fuzzy set mathematics, and (3) a consensus approach to assessing the fuzzy sets themselves provided a reasonable representation of the subjective scoring of the same data by a large number of individuals.

A Quantitative Definition of Target Orthogonality

It is often of interest to define how similar or dissimilar targets are to each other. For example, free-response experiments like the

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ganzfeld often use target packets, with the unselected targets in a packet serving as decoys for judging. Assigning potential targets to packets would be easier with some measure of target orthogonality.

Target definition for the purposes of this mode of analysis is exactly the same as the one described (i.e., a given target is defined by its fuzzy subset of the USE, which has been coded to reflect the visual importance of each target element). The average number of elements, of the total of 131, that was assigned a nonzero value for the targets in our pool of 200 was approximately 37, indicating that the fuzzy set representation of the target pool is rich in visual information. We used this information to determine the degree to which the target set contains visually similar targets.

It is beyond the scope of this paper to describe the extensive work in the literature seeking to find algorithmic techniques that mimic human assessments of visual similarity. One recent article describes techniques similar to the one we used (Zick, Carlstein, & Budescu, 1987).

We begin by defining the simlarity between target i and target j to be a normalized fuzzy set intersection between the two target sets:

$$S_{ij} = \frac{\left(\sum_k W_k \min\{\mu_k(T_i), \mu_k(T_j)\}\right)^2}{\sum_k W_k \mu_k(T_i) \sum_k W_k \mu_k(T_j)},$$

where the index k ranges over the entire USE. We have allowed for the possibility of weighting the membership values with weights W_k to examine various level/element contributions to the target similarities.

For N targets, there are $N(N-1)/2$ unique values (19,900 for $N = 200$) of S_{ij}. The values i and j that correspond to the largest value of S_{ij} represent the two targets that "look" most similar. Suppose another target m is chosen and $S_{m,i}$ and $S_{m,j}$ are computed. If both of these values are larger than $S_{m,n}$ (for all n not equal to i or j), then target m is assessed to be most similar to the pair ij. The process of grouping targets based on these similarities is called *cluster analysis*.

Using this process, 200 targets were grouped into 19 clusters, such that the targets are similar within a cluster, and dissimilar between clusters. Table 2 provides an overview of the 19 clusters found from the total analysis of the 200 targets. Some of the names appear to be quite similar, but, in fact, these sets are visually quite distinctive. Figure 4 shows the graphic output of a single cluster in detail. A much more complex—and visually difficult to understand—graph is generated for the full cluster analysis and is not included here; this smaller subset, therefore, has been chosen to be illustrative of the whole analysis. All targets in this particular sample cluster are islands; the island in each photograph is visible in its entirety. Except for one outlier (i.e., a hexagonal building covering an island), the islands fall into two main groups (i.e., with and without

TABLE 2
NAMES OF THE 19 CLUSTERS

No.	Name	No.	Name
1	Flat towns	11	Cities with prominent geometrics
2	Waterfalls	12	Snowy mountains
3	Mountain towns	13	Valleys with rivers
4	Cities with prominent structure	14	Meandering rivers
5	Cities on water	15	Alpine scenes
6	Desert/water interfaces	16	Outposts in snowy mountains
7	Deserts	17	Islands
8	Dry ruins	18	Verdant ruins
9	Towns on water	19	Agricultural scenes
10	Outposts on water		

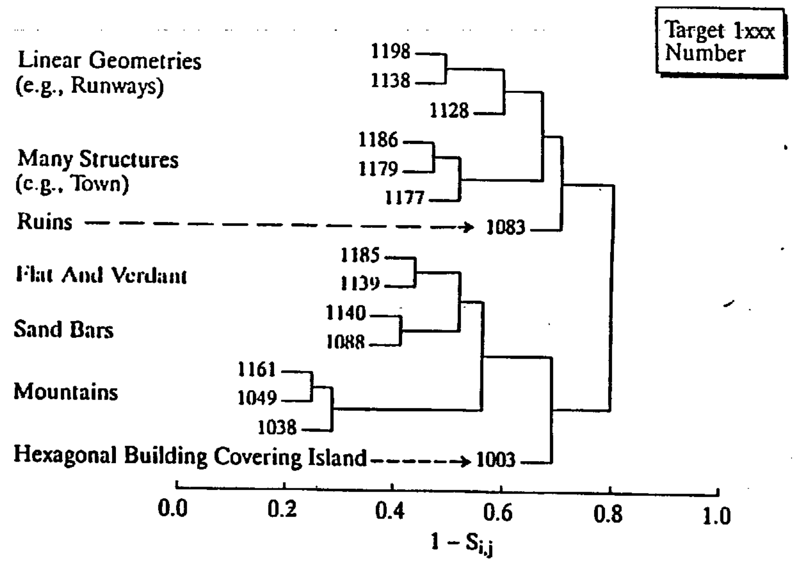

Figure 4. Cluster analysis of island targets.

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manmade elements). The natural islands include three similar mountain islands, two sandbars, and two flat verdant islands.

Using cluster analysis in conjunction with fuzzy set analysis provides for a quantitative definition of sets of targets that are similar to each other within a cluster, but visually different across clusters. Orthogonal clusters can be used to provide visual decoy targets for traditional rank-order judging.

Recommendations and Conclusions

To apply the analysis in its present form to a long RV series is quite labor intensive and, from the results shown in Figure 3, is most likely not justified since this fuzzy set technique approximates human assessment. As we stated in the introduction, however, we are providing only a progress report of ongoing research. Because of the decision concepts described in Dawes (1988) and the obvious benefits of an automated evaluation system, the effort to improve what was described in this paper is certainly justified. The procedure can be used "as is" to improve and quantify target orthogonality.

Several future research areas are suggested to improve the techniques described in this paper. The use of both inter- and intra-level weighting factors needs to be examined systematically. In the analysis described above, all levels and elements were accorded equal weight. The ideal goal would be to determine the optimal weighted mix of abstract versus concrete elements, as a means to achieving the following objectives:

1. Refinement of the cluster analysis for targets, in an effort to simulate, as closely as possible, what is meant by "visual similarities" between targets.

2. Refinement of the analysis of responses, in an effort to achieve even greater correlations between the fuzzy set figure of merit analysis and various forms of ground truth.

Another area that requires examination in some detail is the USE and the hierarchical nature of its structure. It is probable that some elements are more appropriate than others; furthermore, they might be more effectively structured in a semantic network as opposed to a true hierarchy. If a hierarchical structure is retained, then some attention must be paid to the formulation of logical consistency rules that govern element use. This would include numerical relationships governing the membership values (μ's) of higher-order elements (e.g., *port*) vis-à-vis the combined value of their constituent parts (e.g., *city, river, boats, jetties, commercial*).

One inadequacy of the system is that it atomizes conceptual "units." For example, if the response element is *red box*, information is lost in separating *red* from *box*. Current research in fuzzy set theory indicates that fuzzy aggregates of fuzzy elements—"fuzzy sets of fuzzy sets"—are mathematically complex but possible. Some effort should be made to determine whether this technology could be implemented as a means to capturing the information content of the RV response with greater accuracy.

For the visual analysis, research into visual similarities between pictures of natural scenes may serve as a potential refinement tool. The aim here would be to enhance the visual orthogonality of rank-order analysis decoy targets as much as possible. Experiments in normal perception of similarities would assist in determining whether scenes are perceived as similar because of their low-level geometries, concrete elements, or some combination of factors. The ultimate aim would be to refine the target cluster analysis such that it closely simulates ground truth representations of orthogonality.

Appendix A
Coding Forms for the Universal Set of Elements

The following coding forms illustrate the use of a universal set of elements (USE) that matched our particular special targets, viewers, and requirements. We constructed our USE by including a list of features present in photographs from the *National Geographic* with elements obtained from the remote-viewing responses in earlier experiments.

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CONCRETE DESCRIPTOR LEVELS I

Experiment: ______
Trial: ______
Resp./Targ: ______
Coder: ______
Viewer: ______

LEVEL	SINGLE STRUCTURES	SUBSTRUCTURES
10	1 ☐ fort 2 ☐ castle 3 ☐ palace 4 ☐ church (other religious buildings, monastery) 5 ☐ mosque 6 ☐ pagoda 7 ☐ coliseum (stadium, amphitheater, arena)	
9	8 ☐ bridge 9 ☐ [dam (lock, spillway)]	10 ☐ boats (barges) 11 ☐ pier (jetty) 12 ☐ [motorized vehicles (cars, trucks, trains)] 13 ☐ column 14 ☐ spire (minaret, tower) 15 ☐ fountain 16 ☐ fence 17 ☐ arch 18 ☐ wall (e.g., the Great Wall) 19 ☐ monument
8		20 ☐ roads

Figure A1. Coding form.

CONCRETE DESCRIPTOR LEVELS II

Experiment: ______
Trial: ______
Resp./Targ: ______
Coder: ______
Viewer: ______

LEVEL	SETTLEMENT	ELEVATION	LAND/WATER INTERFACE	NO WATER OR VEGETATION	VEGETATION	AMBIENCE/ FUNCTION
7			21 ☐ port (harbor) 22 ☐ [oasis]		23 ☐ agricultural fields (orchards)	24 ☐ industrial 25 ☐ recreational 26 ☐ religious 27 ☐ mechanical 28 ☐ technical 29 ☐ agricultural 30 ☐ commercial 31 ☐ wilderness 32 ☐ urban 33 ☐ rural (pastoral) 131 ☐ historical (archaeological)
6	34 ☐ ruins (incomplete buildings)	35 ☐ mesa (plateau)	36 ☐ waterfall 37 ☐ glacier 38 ☐ canal (channel, manmade waterway)	39 ☐ desert	40 ☐ forest 41 ☐ jungle 42 ☐ swamp (marsh)	
5	43 ☐ isolated settlement 44 ☐ town (village) 45 ☐ city	46 ☐ single peak 47 ☐ hills (slopes, bumps, humps, mounds) 48 ☐ mountains 49 ☐ cliff(s) 50 ☐ [plain, delta] 51 ☐ valley (cleft, gully, irreg. depression) 52 ☐ canyon 53 ☐ [crater, bowl-shape, regular	54 ☐ unbounded large expanse of water (ocean, sea) 55 ☐ completely bounded expanse of water (lake, pool, pond) 56 ☐ partially bounded expanse of water (bay) 57 ☐ island. 58 ☐ river (stream, creek) 59 ☐ coastline		60 ☐ vegetation (trees)	

Figure A2. Coding form.

ABSTRACT DESCRIPTOR LEVELS I

Experiment: ________
Trial: ________
Resp./Targ: ________
Coder: ________
Viewer: ________

QUALITIES

LEVEL	COLOR	OTHER VISUAL	IMPLIED TEXTURE	IMPLIED TEMPERATURE	IMPLIED MOVEMENT	AMBIENCE
4	61 yellow	71 shiny (reflective)	80 smooth	85 hot	89 flowing	91 congested (cluttered, dense, busy)
	62 orange	72 [gold]	81 fuzzy	86 cold (snow, ice)	90 other implied movement	92 serene (peaceful, unhurried, unfrenetic)
	63 red	73 [silver]	82 grainy (sandy, crumbly)	87 humid		93 closed in (claustrophobic)
	64 blue	74 [chrome]	83 rocky (ragged, rugged, jagged, rubbled, rough)	88 dry (arid)		94 open (spacious, vast, expansive)
	65 green	75 [copper]	84 striated			95 ordered (aligned)
	66 purple (pink)	76 obscured (fuzzy, dim, smoky)				96 disordered (jumbled, unaligned)
	67 brown (beige)	77 cloudy (foggy, misty)				
	68 black	78 old				
	69 white	79 weathered (eroded, incomplete)				
	70 grey					

ARCHETYPES

LEVEL	STRUCTURE	ELEVATION	INTERFACE	UNIQUENESS	AMBIENCE
3	97 building(s) (structure(s))	98 rise (vertical rise as well as slope)	100 light/dark areas (big swaths)	104 single (or central) predominant feature	106 manmade (or altered)
		99 flat	101 boundaries	105 odd (or surprising) juxtaposition of elements	107 natural
			102 land/water interface		
			103 land/sky interface (horizon)		

Figure A3. Coding form.

ABSTRACT DESCRIPTOR LEVELS II

Experiment: ________
Trial: ________
Resp./Targ: ________
Coder: ________
Viewer: ________

2-D & 3-D GEOMETRIES

LEVEL	RECTILINEAR FORMS	CURVILINEAR FORMS	MIXED FORMS	IRREGULAR FORMS	REPEAT MOTIF
2	108 rectangle (square, box)	112 circle (oval, sphere)	114 cylinder	117 irregular forms (irregular features)	118 repeat motif
	109 triangle (trapezoid, pyramid)	113 [torus]	115 cone		
	110 other polygonal (> 4 sides: hexagon, octagon, etc.)		116 semicircle (hemisphere, dome)		
	111 cross-hatch (grid)				

1-D GEOMETRY

LEVEL			
1	119 stepped	127 arc (curve)	130 meandering curve
	120 parallel lines	128 wave form (ripples)	
	121 vertical lines	129 spiral	
	122 horizontal lines		
	123 diagonal lines		
	124 V-shape		
	125 inverted V-shape		
	126 other angles		

Figure A4. Coding form.

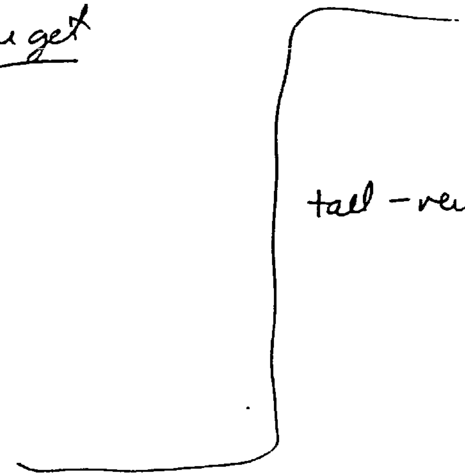
Appendix B
Fuzzy Set Analysis Testbed

The following pages show the targets, responses, and analysis for two remote-viewing trials.

Figure B1. Target for Session 9004.

Task is to identify slide
in PMT holder

Target



tall - vertical feature

break

Figure B2. Page one of the response (Session 9004, Target 1094)

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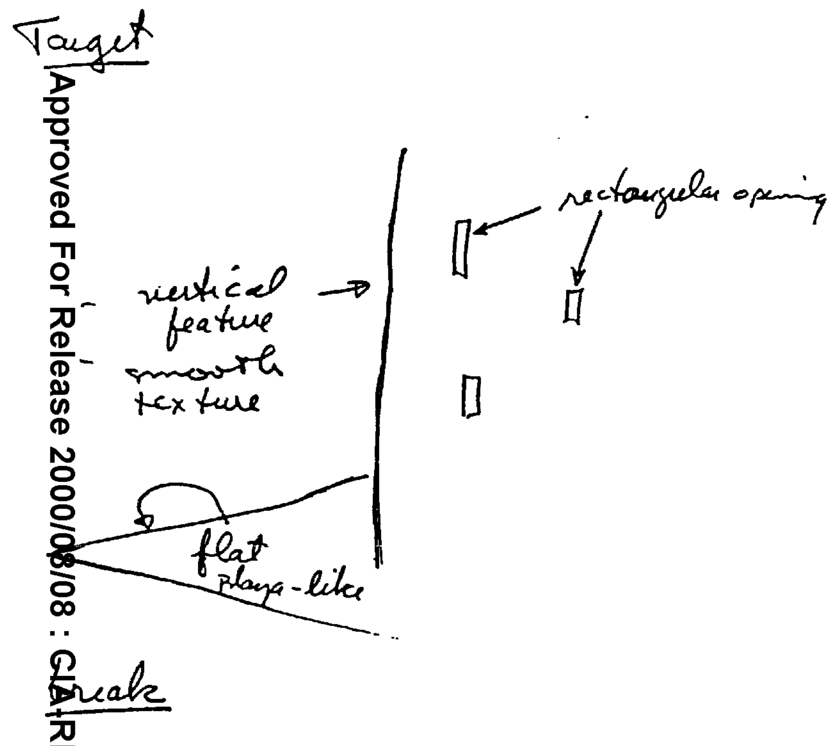

Figure B3. Page two of the response (Session 9004, Target 1094).

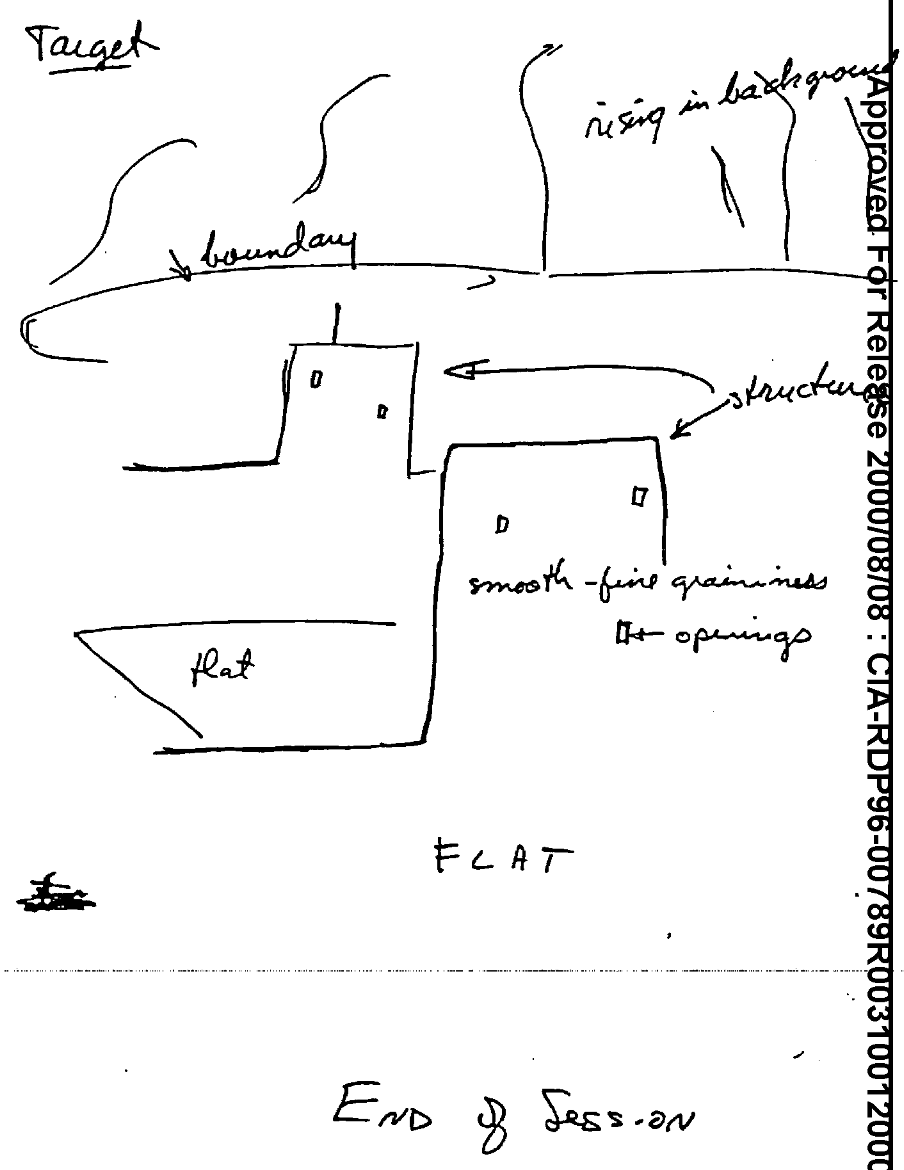

Figure B4. Page three of the response (Session 9004, Target 1094).

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TABLE B1
TARGET–RESPONSE 9004

Element	Name	Target	Response
20	Roads	0.30	0.00
23	Agricultural fields	0.05	0.00
32	Urban	0.00	0.50
33	Rural, pastoral	0.60	0.50
44	Town, village	0.00	0.50
45	City	0.00	0.40
46	Single peak	0.70	0.00
47	Hills, slopes, bumps, mounds	0.10	0.40
48	Mountains	0.00	0.60
49	Cliffs	0.00	0.10
60	Vegetation, trees	0.30	0.00
64	Blue	0.50	0.00
65	Green	0.30	0.00
69	White	0.10	0.00
70	Grey	0.20	0.00
76	Obscured, fuzzy, dim, smoky	0.20	0.00
77	Cloudy, foggy, misty	0.20	0.00
79	Weathered, eroded, incomplete	0.00	0.10
80	Smooth	0.00	1.00
81	Fuzzy	0.20	0.00
82	Grainy, sandy, crumbly	0.20	1.00
90	Other implied movement	0.20	0.00
91	Congested, cluttered, busy	0.10	0.30
92	Serene, peaceful, unhurried	0.40	0.00
93	Closed in, claustrophobic	0.00	0.10
94	Open, spacious, vast	0.60	0.00
95	Ordered, aligned	0.00	0.40
97	Buildings, structures	0.00	1.00
98	Rise, vertical rise, slope	0.60	1.00
99	Flat	0.30	1.00
100	Light/dark areas	0.10	0.00
101	Boundaries	0.30	1.00
103	Land/sky interface	0.50	0.00
104	Single predominant feature	0.60	0.00
105	Odd juxtaposition, surprising	0.30	0.00
106	Manmade, altered	0.20	0.80
107	Natural	0.70	0.20
108	Rectangle, square, box	0.00	1.00
109	Triangle, pyramid, trapezoid	0.60	0.00
115	Cone	0.60	0.00
117	Irregular forms	0.00	0.20
118	Repeat motif	0.10	0.60
119	Stepped	0.10	0.70
120	Parallel lines	0.10	0.00
121	Vertical lines	0.10	1.00
122	Horizontal lines	0.10	0.00
123	Diagonal lines	0.40	0.00
125	Inverted V-shape	0.70	0.00
126	Other angles	0.00	0.10

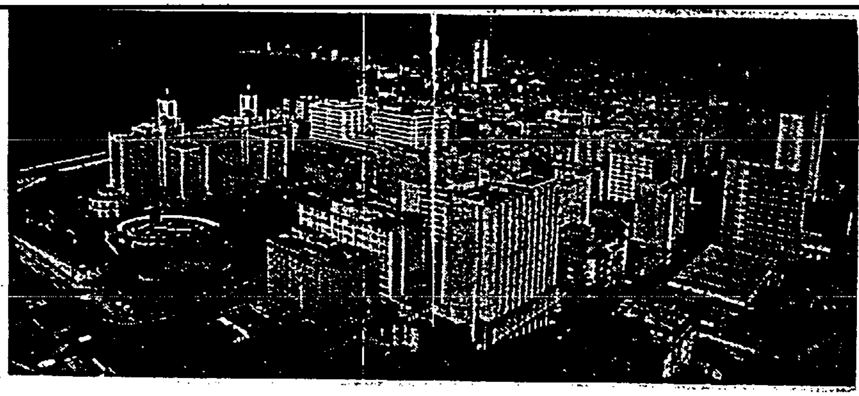

Figure B5. Target for Session 9005.

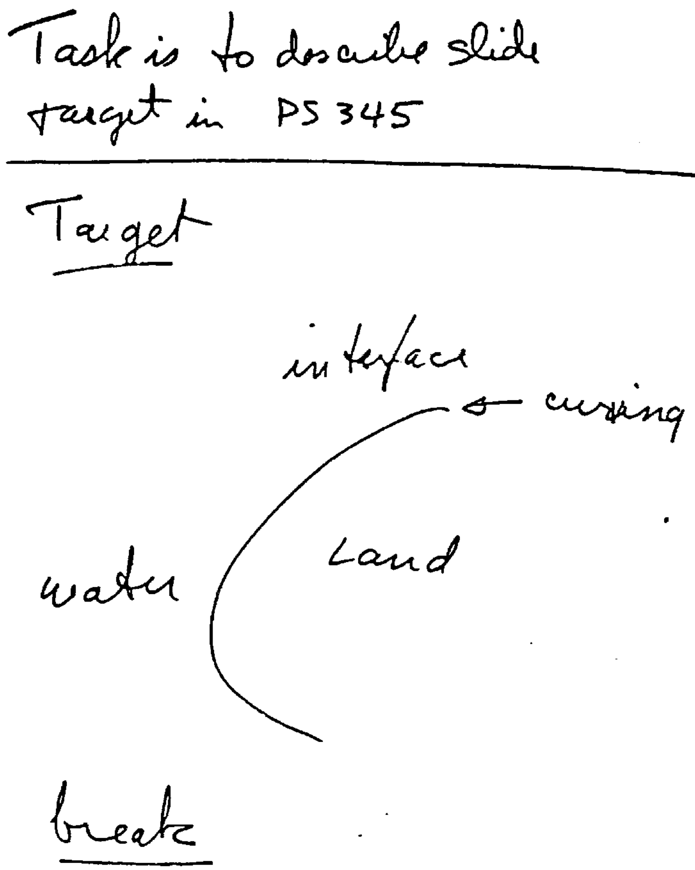

Figure B6. Page one of response (Session 9005, Target 1005).

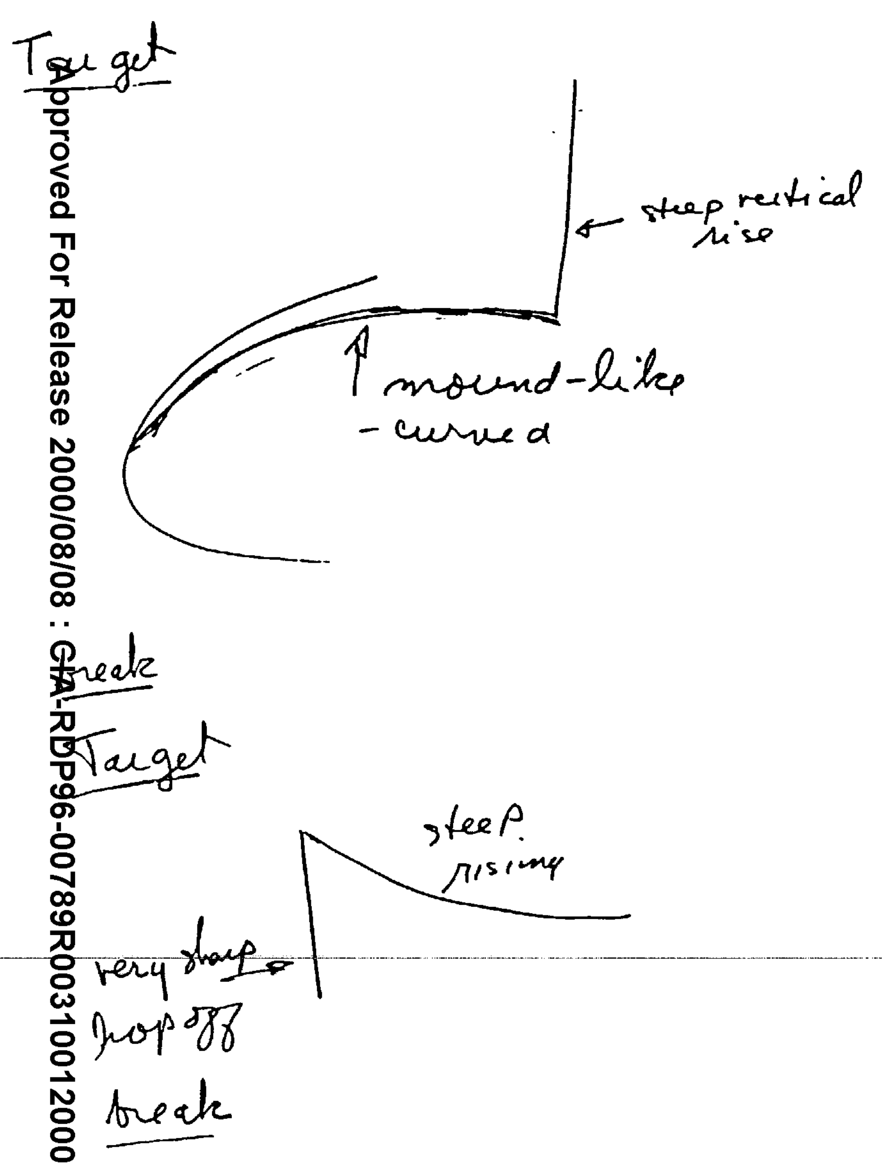

Figure B7. Page two of response (Session 9005, Target 1005).

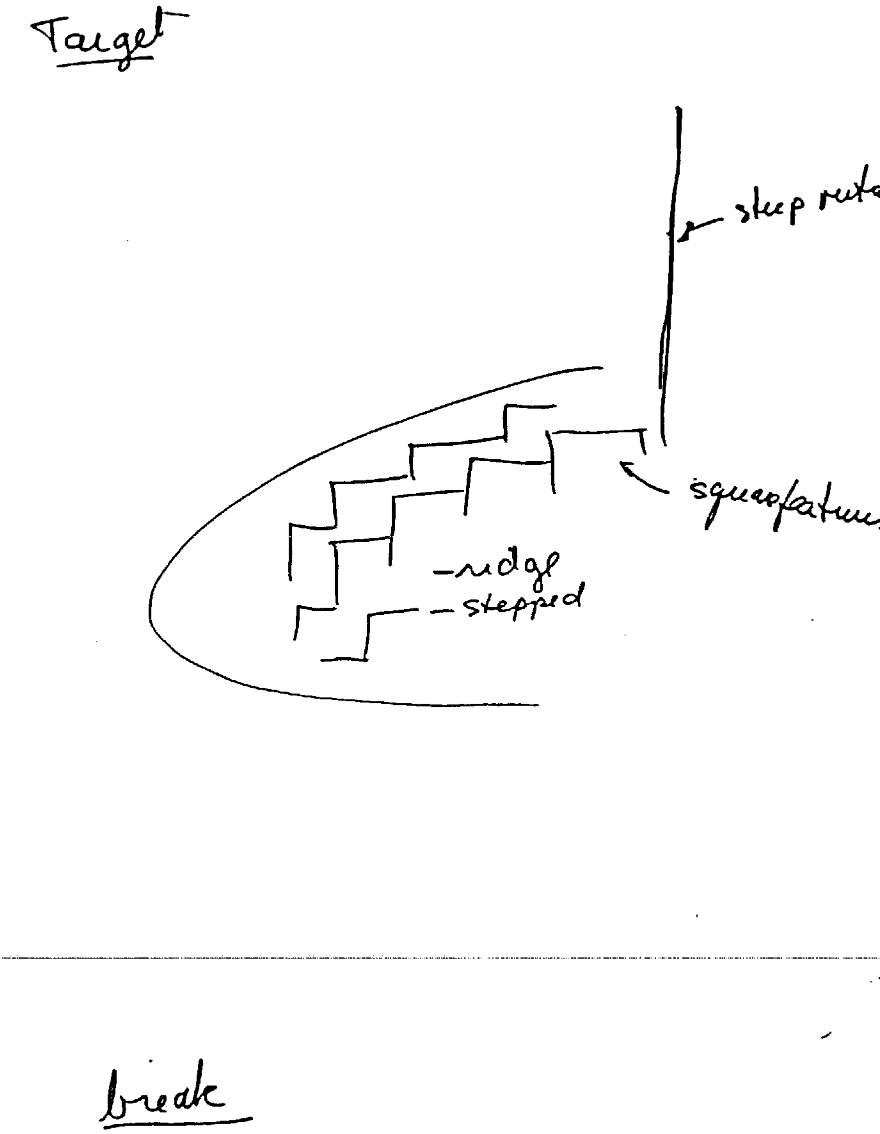

Figure B8. Page three of response (Session 9005, Target 1005).

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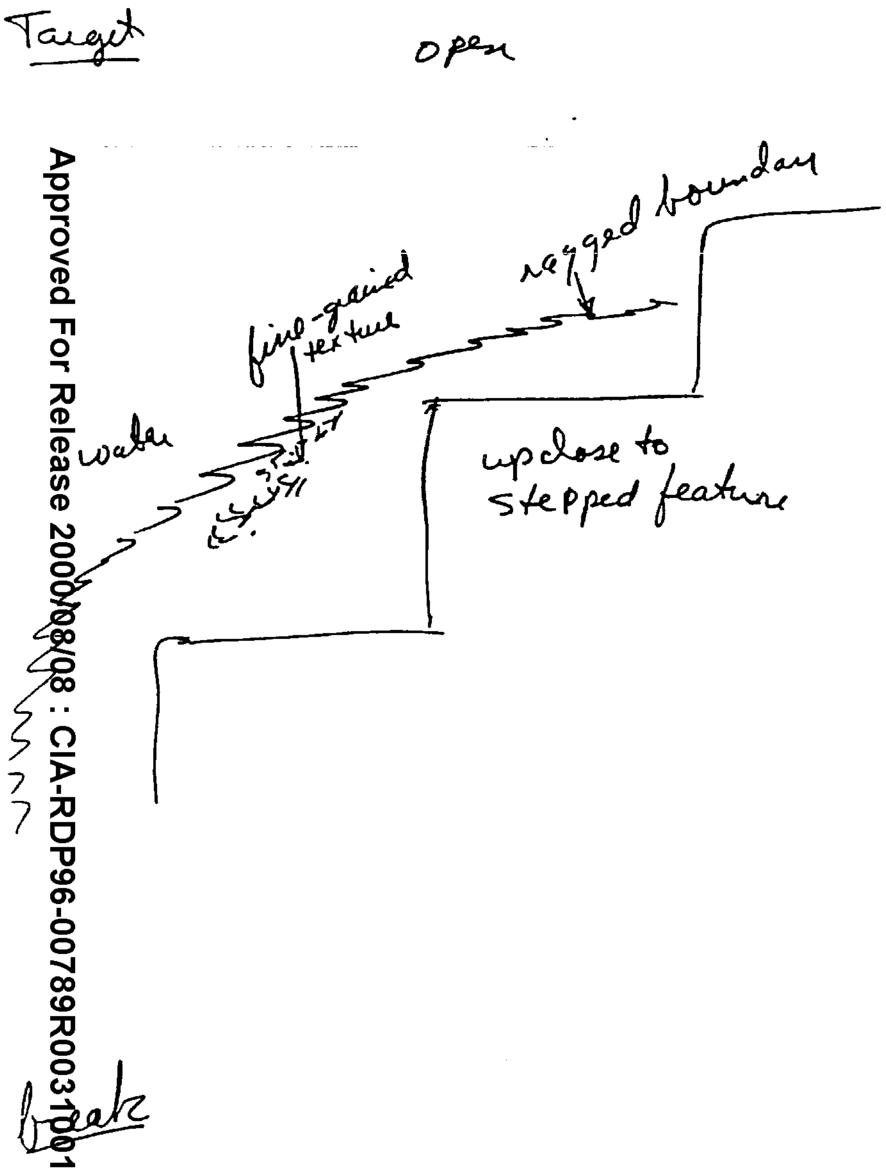

Figure B9. Page four of response (Session 9005, Target 1005).

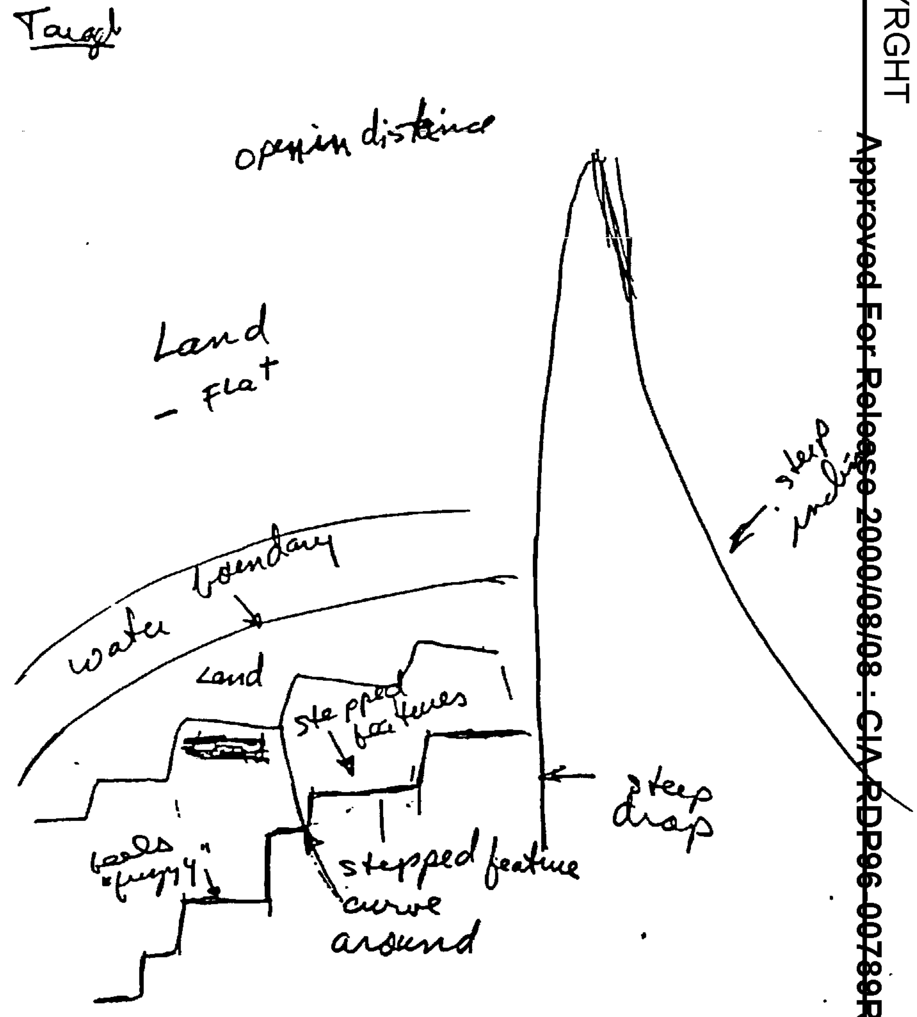

Figure B10. Page five of response (Session 9005, Target 1005).

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TABLE B2
TARGET–RESPONSE 9005

Element	Name	Target	Response	$T_{a=02}$	TOR
14	Spire, minaret, tower	0.00	0.20	0	0.00
20	Roads	0.10	0.10	0	0.00
32	Urban	0.80	0.70	1	0.70
38	Canal, manmade waterway	0.00	0.10	0	0.00
44	Town, village	0.00	0.30	0	0.00
45	City	0.90	0.70	1	0.70
46	Single peak	0.00	0.20	0	0.00
47	Hills, slopes, bumps, mounds	0.00	0.10	0	0.00
54	Unbounded large expanse water	0.00	0.40	0	0.00
56	Partially bounded water	0.30	0.30	1	0.30
58	River, stream, creek	0.00	0.40	0	0.00
59	Coastline	0.00	0.20	0	0.00
60	Vegetation, trees	0.20	0.20	1	0.20
64	Blue	0.25	0.00	1	0.00
65	Green	0.20	0.00	1	0.00
67	Brown, beige	0.50	0.00	1	0.00
69	White	0.10	0.00	0	0.00
70	Grey	0.10	0.00	0	0.00
80	Smooth	0.10	0.00	0	0.00
81	Fuzzy	0.00	1.00	0	0.00
82	Grainy, sandy, crumbly	0.00	1.00	0	0.00
83	Rocky, ragged, rubbled, rough	0.00	1.00	0	0.00
91	Congested, cluttered, busy	0.70	0.70	1	0.70
94	Open, spacious, vast	0.10	1.00	0	0.00
95	Ordered, aligned	0.00	0.30	0	0.00
96	Disordered, jumbled, unaligned	0.30	0.00	1	0.00
97	Buildings, structures	0.80	0.90	1	0.90
98	Rise, vertical rise, slope	0.00	1.00	0	0.00
99	Flat	0.50	1.00	1	1.00
100	Light/dark areas	0.10	0.00	0	0.00
101	Boundaries	0.20	1.00	1	1.00
102	Land/water interface	0.30	1.00	1	1.00
103	Land/sky interface	0.10	0.10	0	0.00
104	Single predominant feature	0.10	0.40	0	0.00
106	Manmade, altered	0.80	0.80	1	0.80
107	Natural	0.20	0.20	1	0.20
108	Rectangle, square, box	0.70	1.00	1	1.00
111	Cross-hatch, grid	0.30	0.00	1	0.00
112	Circle, oval, sphere	0.10	0.00	0	0.00
116	Semicircle, dome, hemisphere	0.10	0.30	0	0.00
118	Repeat motif	0.40	0.80	1	0.80
119	Stepped	0.20	1.00	1	1.00
120	Parallel lines	0.30	0.30	1	0.30
121	Vertical lines	0.50	1.00	1	1.00
122	Horizontal lines	0.10	0.00	0	0.00
123	Diagonal lines	0.10	0.20	0	0.00
125	Inverted V-shape	0.00	0.20	0	0.00
127	Arc, curve	0.30	1.00	1	1.00
128	Wave form	0.00	0.10	0	0.00
Totals			21.20	22.00	12.60

Accuracy = 0.573
Reliability = 0.594
Figure of merit = 0.340

APPENDIX C
"GROUND TRUTH" INSTRUCTION AND CODING FORM

Analysts' Instructions for Remote-Viewing Series 900X

Thank you for helping us perform a *post hoc* assessment of a series of remote viewings. The targets were actually 35-mm slides that were attached to a photomultiplier, a device to measure small amounts of light. We were searching for possible physical correlates to remote viewing.

You will find in your packet 6 remote viewing responses labeled 9001–9006 respectively. Also shown is the target number of the intended photograph. We have supplied the original, rather than the 35-mm slide.

We would like you to make a *subjective* judgment as to the degree of correspondence between the remote viewing response and its associated target. Familiarize yourself with the task by first looking at all the responses and their intended targets. Then, on a session-by-session basis, rate your assessments. You are completely free to define what is meant by "Degree of Correspondence." Indicate your judgment by marking one line across the appropriate continuous scale shown below. A vertical line near the "None" end of the scale will indicate that you feel there is very little correspondence between that response-target pair. Likewise a vertical line near the "Complete" end of the scale will indicate that you feel that there is a significant degree of correspondence.

Many of the responses begin with a little information and build toward a composite drawing at the end. Please assess the response in its entirety as best you can. Thank you again.

SESSION	DEGREE OF CORRESPONDENCE		TARGET
	None	Complete	
9001			1034
9002			1042
9003			1065
9004			1094
9005			1005
9006			1024

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