ABSTRACT: Quantification of the amount of information acquired in successful, forced-choice ESP experiments is possible using a measure of the average number of bits per trial. Using this measure, 53 studies of present-time ESP, where the percipient attempted to call currently existing targets, and 32 studies of precognitive ESP, where the percipient attempted to call targets that would only be generated (by a random process) at some later time, were reviewed. A striking and robust performance difference was found: present-time ESP can work up to 10 times as well as precognitive ESP in forced-choice tests. Three theories are proposed to account for this difference: a psychological theory that there are generally held biases against precognition in Western culture, so percipients don’t try as hard; a two-process theory that present-time ESP and precognition are two basically different processes, with inherently different characteristics; and a temporal-break theory that ESP is a unitary process, but something about the nature of time itself attenuates ESP performance that extends into the future.

INTRODUCTION

In 1980 I became interested in the question “How much information can the ESP channel carry when it is working well?” In some card-guessing experiments, where only a slight (even if statistically significant) deviation from mean chance expectation exists, it seems obvious that little information is being conveyed on each trial; but occasional star performances suggest much greater possibilities. This paper is an initial approach to quantifying the amount of information that a well-functioning ESP percipient can get, with unexpected and important observations about present-time versus precognitive ESP functioning.

Measurement Procedures

Given our present state of knowledge, estimating the amount of information conveyed in a free-response study is very difficult and

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1 A brief version of this paper was presented at the Twenty-Fourth Annual Convention of the Parapsychological Association, Syracuse, New York, August 18-22, 1981.—Ed.

The Journal of the American Society for Psychical Research Vol. 77, October 1983
largely subjective. In this paper, therefore, I decided to deal solely with forced-choice ESP test data: card-guessing studies and similar procedures. In a forced-choice decision, standard information theory tells us the number of bits \( R \) necessary on any trial to make a correct decision. Thus we need only one bit to make a binary decision, but 2.32 bits, on the average, to correctly make a five-choice decision. The number of bits given by this information theory convention is a standardized representation of the amount of information needed, i.e., it is standardized to the convention that all of the information is transmitted in a binary code.

We know that some proportion of correct calls on any forced-choice ESP test are correct by chance alone, however, so we must factor out this chance baseline. Timm's (1973) psi coefficient \( \psi \) is appropriate for this. It is calculated for ESP hitting as follows:

\[
\psi = \frac{H - Np}{Nq}
\]

Here \( H \) is the number of hits, \( N \) is the number of trials, \( p \) is the a priori probability of a hit by chance alone, and \( q = 1 - p \). The psi coefficient for ESP hitting gives us a number between zero and one, and this coefficient represents the proportion of trials on which ESP was presumably operating after chance hits are factored out. Perfect ESP performance on every trial of a run would give \( \psi = 1 \), while no ESP (only chance expectation performance) would give \( \psi = 0 \).

In comparing different experiments, we cannot simply compare statistical significance levels to see which was more successful unless the a priori probability of a hit and the number of trials in both experiments were identical. The same proportional deviation from mean chance expectation can lead to much higher significance levels in a 10-choice test as compared with, say, a two-choice test. The psi coefficient provides a straightforward comparison of the proportion of the time psi was presumably operating in two or more experiments, but it totally ignores the fact that one test may be more difficult, requiring more information to be conveyed for a hit, than another. Thus I devised the following measure, \( \bar{R}_\psi \), to measure the average amount of information conveyed per trial in a particular experiment.

\[
\bar{R}_\psi = R_{\psi} \psi
\]

\( \bar{R}_\psi \) measures of different experiments cannot be so simply compared, since \( \psi \) varies from one experiment to another. In other words, \( \bar{R}_\psi \) is a measure of the maximum channel capacity of the psi coefficient, \( \psi \).

Maximum Channel Capacity

Being an optimist about our potential ability to make ESP work well, I am interested in just how well it can work; what indications do we have of maximum possible ESP channel capacity?

I model the degree to which ESP functions for a given individual at a given time as a function of the individual's innate ability, how strongly this ability was (usually) suppressed or cultivated in his or her development, and multiple psychological factors (internal state and external testing conditions) affecting a given performance. Since we seldom seriously select for high innate ESP ability or ESP ability that has been thoroughly cultivated before a percipient comes to the lab, and since our current understanding of and ability to control psychological factors affecting performance are very poor, it follows that the typical ESP performance in the laboratory is under far from optimal conditions, and so is almost useless in estimating maximum possible ESP performance ability. Only the best performances will be useful for this estimation. Possible channel capacity must be at least as high as (or higher than) our highest observed capacities.

To estimate maximum ESP channel capacity, I quickly scanned the literature for studies that I recalled from memory that were methodologically sound and highly successful. My memory turned out to implicitly define "highly successful" primarily on the basis of extremely high (often 10^-6 to 1 and better) odds against the results being due to chance. I reviewed some dozen studies selected this way and calculated the mean bit rate per trial \( \bar{R}_\psi \) for them. Since I was interested in maximum performance possibilities, whenever studies were broken down into individual percipient data or individual run or condition data, I used the most successful unit (individual and/or condition) of analysis. Thus I used four known perfect Zener card runs (conveniently summarized in Rhine, 1964) to get four indications that maximum channel capacity might go as high as 2.32 bits per trial, rather than submerging these runs into the larger overall studies of which they were a part.

As would be expected, some of the studies that were very statistically significant were not impressive at all in terms of average information conveyed per trial. Ryzl’s percipient, Pavel Stepansen, for example, scored 11,978 hits in 19,350 binary calls (Ryzl, 1966), a result which has enormous odds against its being
due to chance \( (p \ll 10^{-20}) \), but this performance represents a quite low bit rate per trial: \( \bar{R}_s = .04 \).

I found 10 instances of bit rates that were greater than one bit per trial, the highest being two instances of 5.7 bits per trial on confidence calls for exact hits, using ordinary playing cards as targets (Kanthamani and Kelly, 1974). Thus we can tentatively conclude that maximum channel capacity for ESP may be in the five to six bits-per-trial range, and possibly higher.

**Is Precognition Harder?**

In examining the previous studies in order to estimate maximum channel capacity, I retrospectively noted that none of the very successful studies involved precognitive ESP, only present-time GESP or clairvoyance. A dozen studies is not a large sample, but it still seemed odd that not a single precognitive study showed up. I therefore decided to systematically review the bulk of the published, successful ESP studies so that I could compare present-time ESP with precognitive ESP.

**LITERATURE REVIEW**

I reviewed the literature, subject to the following restrictions: First, I reviewed only studies in which there was clear evidence of ESP hitting as a main effect, significant at the .05 level of significance or better. I call these "successful" studies. Studies whose only significance involved differential effects, psi-missing, etc., were excluded. Second, I continued using only forced-choice studies, which lent themselves to accurate quantitative evaluation of bit rate per trial. Third, I assumed that the methodology for each trial, but in free response studies they may often devote 20 minutes or more to a single response. It may be that the same low information acquisition rates apply to free-response studies, and it is just the summing up of many items over the longer time periods that creates the impression of high information acquisition rates. Obviously research is needed here that takes the time devoted to the ESP task into account.

**RESULTS**

**Distribution of Bit Rates in Experimental Studies**

Figure 1 shows the relationship between level of ESP performance and the time interval between response and target genera-
Fig. 1. Relationship between level of ESP performance in mean bits per trial ($\bar{R}_p$) and temporal interval between response and target generation. Note that both axes are logarithmic, to handle the wide data range, and are broken at their low ranges.

Information Acquisition Rates

For all 85 experiments, logarithmic scales were used for both vertical and horizontal axes because of the wide range of data to be plotted. $\bar{R}_p$ ranges from a low of .02 bits per trial to a high of 5.7 bits per trial, and the time intervals in precognition studies range from the fractional second intervals in electronic machine-tested precognition to one year. Many of the electronic machine-based precognition studies do not specify the exact interval that elapsed between the time the response was recorded and the time the random generator generated the precognitive target, so as a graphical convention I have assumed this interval to be .2 second in all such studies.

As can be seen, there are many studies, both present-time and precognitive, in which the measured channel capacity is quite low. If we want to characterize the best of successful (given the sampling restrictions) experimental parapsychology as a whole, combining both the present-time and precognitive studies, we could say that clearly successful forced-choice ESP studies show an information rate of .49 bits per trial on the average, with a standard deviation of $+1.04$ bits. The very large standard deviation here reminds us of what is shown graphically, viz., that bit rates are not normally distributed. Judging from the graph, most successful ESP experiments show an information rate somewhere between .04 and 4 bits per trial, an order of magnitude variation. The most successful conditions in successful ESP experiments have yielded another order of magnitude better results, with occasional results up to 5.7 hits per trial.

Present-Time ESP versus Precognition. Figure 1 suggests a dramatic difference in maximum bit rate per trial between present-time and precognitive ESP. To test the significance of this difference, I used a Mann-Whitney $U$ test (Siegel, 1956). (The $U$ test is almost as powerful as a conventional $t$ test, but does not make the assumptions of normality of distribution that would invalidate the use of a $t$ test on this data.) As Figure 1 shows, present-time ESP results can range an order of magnitude higher than precognition tests in mean bit rate per trial. The overall distribution differences are significant ($U = 462$, transformed $Z = -3.50$ at $p < 5 \times 10^{-4}$, two-tailed. Bearing in mind the above cautions about lack of normality, present-time ESP studies show a mean of .70 bits per trial (standard deviation is 1.27), while precognitive ESP studies show a mean of only .13 bits per trial (standard deviation of .14). Precog-

* Readers used to linear coordinate graphs should remember that logarithmic graphs visually compress differences that would be striking on linear coordinates. Comparing Figure 1 and Figure 2 will be helpful.
or present-time clairvoyance procedures: my personal bias is to expect that the act of ‘sending’ can be an active psi process. The quality of that ‘sending’ act would be quite variable in GESP studies in general, but still present.

One of the 53 studies did not lend itself to a clear classification as clairvoyance or GESP, and so was omitted. Otherwise there were 14 GESP studies and 38 clairvoyance ones. Inspection of the distributions showed strong departures from normality, so the Mann-Whitney *U* test was again used for comparison. Contrary to my expectations, there is a suggestion that clairvoyance procedures produce higher hit rates than GESP techniques (*U* = 175, transformed *Z* = -1.88; *p* < .06, two-tailed). I would not make too much of this finding, however, as a change in a single top data point from the clairvoyance to the GESP column would destroy this suggestive difference. It seems most conservative to conclude that GESP versus clairvoyance conditions seem to make no difference in this sample of successful ESP studies. This should not be generalized to parapsychological studies in general, however, given the restrictive sampling criteria used in collecting the present data.

Precognition and Temporal Distance

Since most ordinary physical energies fall off in intensity with increasing spatial distance, the question whether precognitive performance might, analogously, fall off with increasing temporal distance? between response and target creation is of interest. Ideally this should be investigated by systematic comparisons of various temporal distances within a single experiment, where other factors are held constant; but almost no experiments of this type have been done, so we will examine the present data.

Figure 1 strongly suggests that present-time ESP and precognitive ESP may be different processes: or, if they are a single process, there is a tremendous fall-off in performance in the interval from the present to only .2 second. For all the data plotted in Figure 1 (both present-time and precognitive), the correlation of \( R_p \) and temporal distance is not significant (*r* = -.05), although a linear correlation coefficient may not be appropriate here.

If precognitive ESP is a different process than present-time ESP, then a possible relationship between performance and temporal distance should be examined for the precognitive data alone. Figure 2 plots only the precognitive data, and plots \( R_p \) on a linear, rather than a logarithmic, scale so that differences are more readily grasped. (The time scale is still logarithmic.) Again, however, the linear correlation coefficient is insignificant (*r* = -.05).

Given my interest in maximum performance potential, a third way of modeling the data suggests itself: Consider the largest \( R_p \) at each time interval to be the variable of interest, with \( R_p \) values below that representing less than maximum performances that were determined by variables other than the inherent nature of ESP. That is, less than maximum performances may represent lowered motivation, psychological conflict, nonoptimal experimental conditions, etc., and only the maximal performances need be examined for their relationship to time. If we take the 13 maximal data points in each temporal category (including the present) having at least one data point, we then find that *r* = -.14, which is still insignificant. If we examine the precognitive data alone, with 12 data points, \( r = -.17 \), also insignificant.

The above correlations should be taken with reservations, however: 32 data points are too few to map a range of .2 second to 3.15 \( \times 10^7 \) seconds (one year) adequately. Therefore, while a strong difference between present-time and precognitive ESP performance is clear, the question of possible fall-off of precognitive performance with temporal difference is still open.

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7 As Douglas Dean and I realized in the course of a conversation about precognition some years ago, however, we never deal with only temporal distance in precognition. The movement of the earth around the sun and the drift of the whole solar system through space adds a spatial distance component of about 193.5 miles per second of time.
Information Acquisition Rates

How Frequently ESP is Used

Psi coefficients were computed for the same 85 studies: the results are plotted in Figure 3. The psi coefficient is a measure of how frequently the ESP process is activated, regardless of target difficulty, and so can be used as a rough measure of how hard percipients tried (and succeeded) in using ESP. As with the mean bit rate per trial data, the psi-coefficient analysis shows that ESP is activated much less frequently in precognitive studies than in real-time ESP experiments.

Because the range of psi-coefficient values is not so enormous as that for $R$, descriptive statistics based on assumptions of normality are moderately accurate. For present-time ESP, the mean psi coefficient is .28 with a standard deviation of .32, while for precognitive ESP it is .06, with a standard deviation of .06. The ranges of the psi coefficients displayed are also quite different: no precognitive study exceeds $\psi = .33$ and most (77%) are below .10, while the present-time studies show six instances of perfect ESP functioning and most (56%) show psi coefficients greater than .10. The differences are highly significant ($U = 389, transformed Z = -4.16; p < 3 \times 10^{-4}$, two-tailed).

Discussion

To recapitulate this study's findings, an examination of the bulk of successful, quantitative studies of forced-choice ESP shows that present-time ESP experiments (GESP or clairvoyance) generally have a significantly higher mean information transmission rate per trial than do experiments in precognition. The most successful present-time studies show 10 times more bit acquisition than the most successful precognitive studies. I shall propose three possible theories to account for this difference.

A Psychological Theory

If precognition studies generally don't work as well as present-time ESP studies, it might be due to some actual difference in the processes used for information gathering in the two modes of ESP, or it might be due to a psychological factor. We could hypothesize that because precognition appears harder, given our cultural preconceptions, percipients don't try as hard, and so don't do as well, in precognitive experiments.

A Two-Process Theory

Another theory to account for these data, which I shall call the two-process theory, is that present-time ESP is a different mech-
A Temporal-Break Theory

An alternative hypothesis, which I shall call the temporal-break theory, is that there is only one, unitary ESP process, but external reality itself is strongly different for the present moment and any future moments, so that it is much more difficult to use ESP to get information about the future. Again, we could postulate as an additional theory that temporal distance per se does not matter, only the distinction between present-time and any future time, subject to the paucity of data points mentioned above.

Comments on the Three Theories

As shown in Figures 1 and 3, both the mean bits per trial and the psi-coefficient analyses show that ESP is activated much less frequently in precognitive than in real-time experiments. This could be interpreted as supporting the psychological theory that percipients don’t try as hard (or are not as successful in activating the ESP process in spite of their trying), or as supporting a theory that precognition is inherently harder, for unknown reasons, than present-time ESP. The psychological argument seems moderately plausible, but one would think that of the many percipients involved in 32 successful precognition experiments, surely some would not have an antiprecognition bias. Is cultural conditioning that uniform? Nevertheless, the psychological theory deserves closer examination; it may be that the difference is best explained by some other psychological interpretation not requiring such an antiprecognition bias.

If present-time and precognitive ESP are indeed basically different processes, then they will probably show other kinds of differences in addition to the one reported here. This consequence of the two-process theory is difficult to test at present, as ESP is characterized now as “characterless”—i.e., we do not know of any bounds of quantitative and qualitative aspects of ESP functioning that would limit it in any way and thus constitute characteristics. Given the very few studies of ESP that have been done, however, compared with the number of questions we could ask about it, we may find that ESP has many characteristics that we simply haven’t observed yet. Thus a consequence of the two-process theory is
potentially testable: if we do begin to identify characteristics of 
ESP, then the theory's implication of other differences should 
become testable in practice.

If, on the other hand, the temporal-break theory is a better fit to 
reality, we would not expect to find differences in other qualities of 
present-time and precognitive ESP apart from differences inherent 
in the nature of time itself. What kind of theory of time can we 
envision that gives reality to both the present and the future, but 
makes the present much stronger or more psychically detectable 
than the future? If present-time ESP does produce stronger 
"signals" than precognitive ESP, might this make the discrimina-
tory process I have called trans-temporal inhibition (Tart, 1978) 
more efficient?

It is also possible that precognition per se may not be a single 
process but two or more processes. Russell Targ9 has suggested 
that the plot of $R_{o}$ in Figure 2 resembles radioactive decay plots 
where two different kinds of atoms, with different half lives, are 
present. Thus there might be a short-term precognitive process that 
functions from a fraction of a second to somewhere in the neigh-
borhood of five minutes, and a long-term precognitive process that 
functions at a lower level of information flow but at intervals of up 
to one year. It is possible to carry out a post hoc analysis that 
shows a suggestive difference ($t = 1.93, df = 28, p < .05$, one-
tailed) between precognitive data gathered over temporal intervals 
of more than five minutes versus data gathered over intervals of 
five minutes or less. This is an elaboration of Targ's earlier model 
of precognition (Targ, 1973), which predicted a fall-off in precogni-
tion with increasing temporal distance. Concepts of immediate, 
short-term, and long-term memory have been very useful in under-
standing human memory phenomena, so this type of theorizing 
may be of value in understanding ESP. Predictively based research 
is needed to explore such theories.

The present finding of a large difference between present time 
and precognitive ESP in forced-choice tests is quite robust: it is not 
a small difference that would drop into insignificance with the shift 
of only a few data points. It might be argued that some qualitative 
free-response precognition data suggest high bit rates, but until we 
know how to adequately quantify that kind of data and take re-
sponse time into account, we cannot draw on it very usefully. If 
new studies demonstrate strong precognitive ESP functioning, with 
bit rates in the one to five bits-per-trial range, the present finding 
will be challenged. In addition to general research on the nature of 
precognition then, attempts to produce very high level precognitive 
performances are also necessary, as is research to determine

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9 Personal communication. 1981.

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Information Acquisition Rates

whether we are dealing with psychological factors inhibiting pre-
two kinds of ESP, or a real quality of time.

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