A physical theory of PSI based on similarity

by
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A physical theory of psi is described which can account for a variety of psi phenomena, but which does not contradict ordinary physical observations. In the theory, psi influences events as the result of similarities in the spatial arrangements of matter occurring at different times, leading to quantitative predictions of the probability of observing psi. The results obtained appear consistent with experimental studies of psi.

The theory is applied to several idealized examples representing psi testing situations: a coin toss, a generalized psi experiment, and a sequence of psi experiments. An analysis of experimental controls predicts PK interference, due to experimenter bias and due to the belief patterns of outside observers. Declines in psi scoring are predicted, arising both from the experimental design and from external influences.

Suggestions are given for experimental conditions which should be psi-conducive, and some philosophical implications of the theory are mentioned. Although quantitative verification is still required, the theory should already provide a useful conceptual structure for designing experiments and for interpreting psi processes.

1. INTRODUCTION

This article describes a physical theory for explaining and predicting psi phenomena. Although the theory has broader implications, the present discussion concentrates on psi as it might be observed in laboratory experiments. This theory is closely related to previous work by Schmidt (1975) and Stanford (1978), and in fact provides an underlying psi mechanism which appears compatible with their studies, as discussed later.

By a physical theory we mean a set of definitions and equations with the following properties:

(i) If the conditions of an experiment are specified, the theory yields quantitative predictions of the probabilities of various outcomes;

(ii) The theory treats the properties and interactions of matter in a way which makes no distinction between living and non-living matter.

In order for the theory to be useful, of course, it should be compatible with

observed phenomena (both psi and non-psi) and its predictions should agree
with observation. The theory described here works very well in a qualitative
sense; it has not yet been tested quantitatively.

As a basis for discussion, consider the following possible hypotheses concerning
psi phenomena:

(i)   Psi does not exist;

(ii) Psi exists, but is not explainable using physics;

(iii) Psi exists, and can be explained using presently accepted physical laws; or

(iv) Psi exists, and can be explained using new physical laws which do not
conflict with observed physical phenomena.

If we choose to accept hypothesis (i) or (ii) above, physical science can pro-
ceed no further. Therefore, although one of these two hypotheses may be true,
there is no point in discussing either of them here. Hypothesis (iii) has been
explored repeatedly in the past without providing a useful predictive theory
(e.g., Rhine and Pratt, 1957, 66–77; Heywood, 1959; Smythies, 1967; Chari,
1972; Koestler, 1973; Rao, 1977, 297–299). Therefore, for the purpose of this
article, we will assume that hypothesis (iv) is true.

In the following section, we will show how a suitable physical theory of psi
may be defined. The theory will then be applied to several psi-testing situations
of practical interest. Finally, we will summarize the conditions which are pre-
dicted to be psi-conducive, and draw some general conclusions.

2   DEFINITION OF A THEORY

2.1. Characteristics of psi

To determine what kind of physical laws are needed to accommodate psi, let us
consider some of psi's frequently reported attributes (Rhine and Pratt, 1957;
Murphy, 1961; Thouless, 1963; White, 1976a, 150–153; Rao, 1977). Many
experiments suggest that psi depends on distance either weakly or not at all; it
also appears to be time-independent (e.g., acausal or precognitive). Psi is unreliable
and unpredictable, disappearing with repetitious testing, with tight controls,
and in the presence of hostile observers. ESP appears to act as a feeling or
hunch rather than as a word-for-word message, and is more likely when the
participants have an emotional or empathetic bond. Finally, psi always requires
the involvement of some living organism, as participant or ultimate observer —
no psi-like effect is generally claimed for purely mechanical systems.

These attributes suggest that a physical theory of psi must modify two

cherished principles of physics. which can be expressed non-mathematically as follows:

(i) Causality, the notion that events arise purely from circumstances preceding them in time; and

(ii) Locality, the concept that events which are spatially separated cannot influence one another unless there is some measurable change in the intervening space.

In addition, psi's manifestation as an emotional or psychophysical state in complex organisms suggests that the structural complexity of those organisms may play an explicit role, as postulated by Marshall (1960, 266) and Smythies (1967, 3–4). This idea leads directly to the theory described below. Psi's remaining outstanding attribute, its unreliability, does not seem to help in formulating a theory, but instead appears as a prediction of the theory in certain specific cases.

2.2. Psi as a probabilistic event

We may regard any event with two or more outcomes as a branching point leading to various future paths, as in Figure 1. Each of the time tracks resulting from the event represents a different evolution path of the universe, as affected by the outcome of the event.

In a simple psi experiment, the event we wish to consider is the chance process which determines whether psi is considered successful (outcome 1) or unsuccessful (outcome 2), e.g., the toss of a coin, or a card guess by the subject. If the experimental event occurs at a time t_c, we may represent the psi trial as in Figure 2.
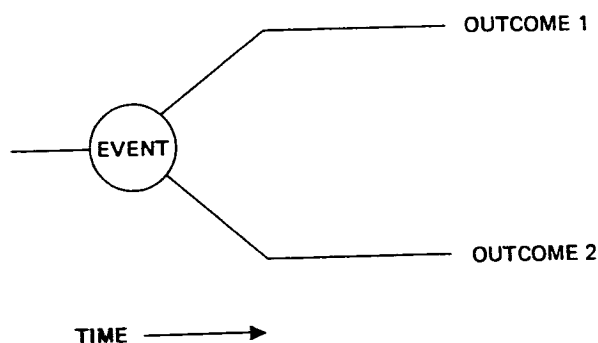

FIGURE 1 Time-track branching at an event with two possible outcomes. The time variable increases to the right.
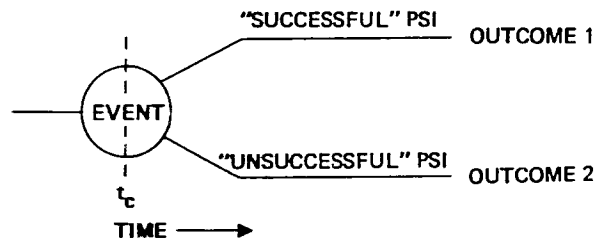
FIGURE 2   Time-track branching in a psi experiment with two possible outcomes. The outcome of the experiment is determined by the event occurring at time t_c.

Let us now define the following probabilities:

p_i = mean chance expectation of outcome i ($i = 1$ or 2), neglecting psi effects.

$\bar{p}_i$ = observed probability of outcome i ($i = 1$ or 2), as influenced by psi.

Evidently,

$$p_1 + p_2 = \bar{p}_1 + \bar{p}_2 = 1 .$$

A successful theory of psi now hinges on answering the question: What physical characteristics of path 1 (in Figure 2) could cause successful psi exceeding chance expectation, that is, $\bar{p}_1 > p_1$?

2.3 A postulate involving similarity

A frequently employed procedure when attempting PK is for the subject to visualize the desired outcome, e.g., a coin toss of heads. It seems evident that if the subject scores a hit, his mental state following the toss (experiencing heads) will bear some resemblance to that prior to the toss (visualizing heads). These similar mental states should be correlated with similar complex patterns of electrochemical neural activity. Thus, we might expect time track 1 in Figure 2 to be characterized by a repetition of certain patterns of neural excitation.

Similar considerations, relating to a variety of psi testing situations, lead us to the following postulate:

Similarity Postulate: Every event tends to produce spatial patterns of matter which are similar to the spatial patterns of matter existing at the time of the event.

Note that this postulate is non-causal, since it implies that an event can be influenced by patterns occurring at a subsequent time.

To make use of the Similarity Postulate in constructing a theory, we need a quantitative measure of similarity. There are many possible ways to define

similarity; in this article we will confine ourselves to a simple definition which seems reasonable, but it is not unique.

Definition. Along any time track i, let $S_i(t_1,t_2)$ denote the similarity between the universe at time t_1, $U(t_1)$, and the universe at time t_2, $U(t_2)$. Let

$$S_i(t_1,t_2) = 1/q_i(t_1,t_2).$$

Then we define

$q_i(t_1,t_2)$ = the probability that a random arrangement of matter
would resemble $U(t_1)$ at least as much as $U(t_2)$ does. (1)

S_i and q_i are evidently nonlocal, since each involves arrangements of matter in the entire universe.

In the following section, we will indicate how q_i, and hence S_i, may be calculated in a simple example. For the present, let us note that very similar arrangements of matter should be improbable, having small values of q_i, and hence large values of similarity S_i. A larger value of S_i, according to the Similarity Postulate, then implies a larger value of $\bar{p}_i/p_i$, i.e., a psi effect.

A theory of psi now consists of two elements:

(i) A procedure for computing similarity values S_i; and

(ii) A prescription for using S_i and the chance expectations p_i to obtain the psi-affected probabilities $\bar{p}_i$.

These parts of the theory will be discussed in the following two sections, respectively.

2.4. Quantitative definition of similarity

Consider two simple arrangements of material particles A and A', as shown in Figure 3. In the case illustrated, we observe that A' can be obtained from A by translating four of the particles in a direction parallel to the x-axis, and rotating the other three particles about an axis parallel to the z-axis.

The seven transformations just described can be plotted as points in a 6-dimensional translation-rotation space which we will denote T6 (see Figure 4). Three coordinate axes in T6 measure translations parallel to the x-, y-, and z-axes, and the other three T6 axes describe the possible rotations of the coordinate system about any fixed point (Mathews and Walker, 1965).

In Figure 4, the four pure translation points are not shown as coinciding exactly, since in practice we cannot determine the location of particles in A and A' more accurately than some distance ds; the three pure rotation points are similarly spread out in T6. Δ represents the distance in T6 (yet undefined)
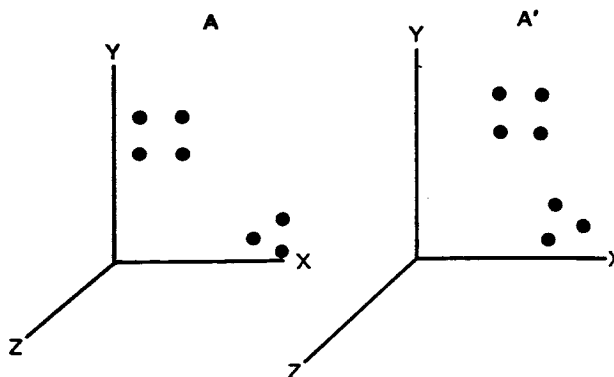
FIGURE 3   Two arrangements A and A' of particles in a three-dimensional space with Cartesian coordinates x, y, and z.

.between the two clusters of translation-rotation values. With Figure 4 as a guide, it is easy to see that similar arrangements in ordinary space lead to clustering in T6 space; hence, q_i of equation (1) may be taken to be the probability that seven randomly placed points would cluster as tightly as shown in Figure 4.

To compute q_i, we begin by considering the location of any one of the points in Figure 4 to be arbitrary. If all the points are constrained to lie within some region of size L, the probability that a randomly placed second point would lie within a distance ds of the first point is $(ds/L)^6$. A third point has a probability $(ds/L)^6$ of lying within ds of the first two, and so forth.

After we have thus finished building up one of the two clusters of points, there is a probability $(\Delta/L)^6$ that the first point of the second cluster will lie within a distance Δ of the first cluster. Continuing this procedure, one obtains
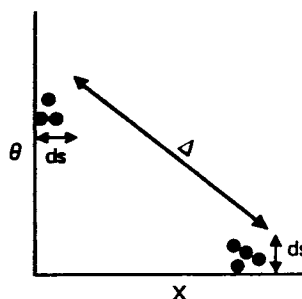

FIGURE 4   Translation-rotation values which transform A into A' in Figure 3, plotted schematically along two axes of a six-dimensional space.

a total probability q_i for Figure 4 of

$$q_i \approx (ds/L)^{30} (\Delta/L)^6 . \tag{2}$$

Smaller values of ds and Δ evidently give smaller values of q_i, or larger values of similarity S_i. It is easy to see that larger values of S_i correspond to patterns A and A′ which we would tend to describe as similar in ordinary speech.

It should be noted that the set of transformations represented by Figure 4 is not unique; there are infinitely many sets of translations and rotations which would transform the particles of A into those of A′. However, the transformation shown can be distinguished from all others because it yields the smallest value of q_i.

The calculation of q_i just described is intended only heuristically, to make it *plausible* that there is a straightforward quantitative way to define the similarity of two arrangements of matter. The exact mathematical definition of q_i for the general case is lengthy, and will be given elsewhere. It involves the following:

(i)   The definition of distances in T6 space;

(ii)   Provision for different numbers of material particles, of differing types, in A and A′;

(iii)   A procedure for calculating q_i which treats all particles identically, and all coordinates in T6 space consistently; and

(iv)   Provision for the fact that material particles are not perfectly localized, but effectively spread out in space according to their quantum mechanical wave functions.

The constant L appearing in equation (2) represents the size of a region containing all the particles in question, and could be interpreted as the size of the universe. However, it does not matter what value we actually take for L, since it turns out that L drops out of the equations when probabilities of events are computed.

The similarity function defined above has some unique properties which make it useful in a theory of psi. In particular, it is much more sensitive to the complexity of an arrangement than to the number of particles participating in the arrangement. If two arrangements A and A′ differ only by rotations and translations of a modest number of relatively rigid objects, the similarity $S(A,A')$ calculated for the two arrangements is many orders of magnitude smaller than if, for example, A and A′ represent similar electrochemical excitation patterns in a complex spatial arrangement of neurons.

To be specific, suppose that arrangement A consists of a group of 1000 one-kilogram rigid masses. If these are translated through distances which average

0.1 m to form a new arrangement A', the loss in similarity in comparison with A is

$$\ln S(A,A) - \ln S(A,A') \approx \ln [0.1m/ds]^{6000} \sim 10^5$$

(taking $ds \approx$ nucleus radius $\sim 10^{-15}$m). However, the corresponding quantity for changes in the excitation pattern of 10^6 brain neurons turns out to be roughly 10^{18}. It is not the animate nature of the neuron arrangement which causes this immense difference, but only the complexity of its pattern (the number of separate structures, and the lack of a periodic spatial pattern in the structures). Thus a psi theory which incorporates this sort of similarity function may predict psi effects as a result of changes in brain neurons (or, perhaps, changes in other complex structures such as programmable electronic circuits), but no unusual effects in ordinary physical, chemical, and mechanical processes.

The numerical evaluation of S_i for specific brain patterns is very lengthy, and depends upon the details of the neural model adopted. These difficulties can be avoided if the S_i are simply treated as unknowns, and the experiment is designed so that their numerical values are not required; for example, S_i could be determined in a pre-test, and those values then used in the main experiment. The present article concentrates on predictions and experimental comparisons which do not require explicit numerical evaluation of S_i.

2.5. A theory of psi probabilities

Having specified how to compute the similarity S_i, and knowing the conventional probabilities p_i, we need to know how the psi-influenced probabilities $\bar{p}_i$ can be calculated. There are many possible relationships between S_i, p_i and $\bar{p}_i$, but most of these either disagree with numerous scientific observations, or predict vastly erroneous probabilities for psi phenomena (i.e., either zero or near-certainty). To save space, we will present a plausibility argument leading directly to a useful, and apparently correct, result.

We begin by dealing not with S_i, but its inverse q_i. We allow the conditions surrounding the psi experiment to play an explicit role by considering the quantity

$$q_i(t_c,t) ,$$

where t_c is the time of the psi event (as in Figure 2) and t is an arbitrary time along the time track i.

How can we interrelate $p_i, \bar{p}_i$, and q_i? Each of these is a probability, although they certainly have quite different meanings. The simplest approach would be to assume that two of these quantities are independent, and combine them as a product or sum to produce the third quantity. There are several ways to do this, but we are guided by two considerations:

(i)   According to the Similarity Postulate, smaller values of q_i should correspond to larger values of $\bar{p}_i/p_i$; and

(ii) There should be some rough proportionality between p_i and $\bar{p}_i$, so that events which are extremely unlikely ($p_i \to 0$) do not become near-certainties under the influence of psi.

These considerations justify assuming the relationship

$$p_i/\bar{p}_i \propto [q_i(t_c,t)]^n ,$$

where n is some constant, a positive number.

In order that similarity contributions from various times can contribute, we assume that q_i values for different times t can be treated independently. Combining these values yields

$$p_i/\bar{p}_i \propto \prod_{\text{all } t} [q_i(t_c,t)]^n$$

$$\propto \exp\{\zeta\textstyle\int \ln q_i(t_c,t)\,dt\} ,$$

where ζ is a new positive constant.

Finally, we replace the proportionality with an equality and rearrange the equation to obtain

$$\bar{p}_i = C p_i \exp\{\zeta\textstyle\int \ln S_i(t_c,t)\,dt\} . \tag{3}$$

The positive constant C is chosen to conserve probability:

$$\sum_i \bar{p}_i = 1 \tag{4}$$

Thus ζ is the only adjustable parameter in this theory. Analysis of typical psi experiments using this theory suggests that the correct value for ζ lies in the range 10^{-20} to 10^{-18} sec^{-1} . It is tempting to equate ζ to the Hubble constant (approximately 2×10^{-18} sec^{-1}), either with or without a multiplicative constant. The Hubble constant describes the expansion rate of the universe and its reciprocal approximates the age of the universe; thus such a factor would effectively convert the integral in equation (3) to a time average.

2.6. Summary of the Theory

Suppose that we wish to calculate the effect of psi on any event with more than one possible outcome. In principle, we can compute the quantities q_i of equation (1) along each of the possible time tracks produced by the event. Then equations (3) and (4) predict the psi-influenced probabilities of these various outcomes.

In a practical psi experiment, we do not know the location of every material

particle in the universe from which to compute q_i. However, as discussed in the following section, under certain conditions we can ignore the rest of the universe, and include only the experiment and its immediate surroundings.

3.   PRACTICAL EXAMPLES

The theory outlined above will now be applied to examples which, although they are simplified, have practical interest.

3.1. Isolation of a psi experiment

The similarity function $S_i(t_c,t)$ appearing in equation (3) is generally the product of a number of terms, each of which arises from a specific set of material particles. This is evident in the example of Figure 4 and equation (2), in which q_i is the product of terms arising separately from the group of four particles and the group of three particles, multiplied by a term $(\Delta/L)^6$ depending upon their relative displacements.

Suppose that we consider a psi experiment whose ordinary causal effects are confined to a spatial volume V and a time interval $[t', t'']$ containing the time t_c of the psi event. Then we may generally write S_i as a product:

$$S_i(t_c,t) = S_i^E(t_c,t) S_i^U(t_c,t), \quad t' \leqslant t \leqslant t'', \tag{5}$$

where S_i^E is the similarity computed only including particles within the experimental volume V, and S_i^U is the similarity computed for the rest of the universe. (Exceptions to equation (5) would be instances where the psi experiment involves the synthesis or destruction of complex spatial patterns of matter.)

Since the outcome of this experiment does not affect the universe outside volume V during the experiment,

$$S_i^U(t_c,t) = S_j^U(t_c,t), \quad t' \leqslant t \leqslant t'', \tag{6}$$

where i and j represent any two of the possible experimental outcomes. Moreover, since the effects of the outcome are limited to the time interval $[t',t'']$,

$$S_i(t_c,t) = S_j(t_c,t), \quad t<t' \text{ and } t>t''. \tag{7}$$

(The reader may ask: May not someone outside the experiment telepathically sense its outcome, thereby violating equation (6) or equation (7)? It turns out that in the present theory telepathy does not occur unless some means is provided for subsequently verifying its accuracy, which in this case is forbidden by the assumptions of the experiment. For a similar discussion, see Schmidt (1978, 473.)

We may now compute the ratio of the probabilities of two different outcomes of the experiment, conveniently eliminating the constant C, using equations (3), (5), (6), and (7). We find

$$\bar{p}_i/\bar{p}_j = (p_i/p_j)\exp\{\zeta\int_{t'}^{t''} [\ln S_i^E(t_c,t) - \ln S_j^E(t_c,t)] \, dt\}. \tag{8}$$

In other words, the relative probabilities of various experimental outcomes are independent of what happens outside the experiment, and can be calculated using only the parameters of the experiment itself. (We assume, of course, that the fundamental constant ζ has been measured by some previous experiment.) The difficulty of achieving the required degree of experimental isolation will be discussed in the later example "Inertia of Beliefs" (section 3.5).

3.2. Example: coin tossing

Consider an idealized PK experiment in which a subject tries to influence a coin toss by visualizing the coin landing heads up. For simplicity, we assume that the experiment consists only of the subject and the coin, isolated from the rest of the universe, as defined in the previous section. An experimenter can be included by obvious extensions of the discussion below.

Define the neural excitation patterns of the subject as follows:

P_1 = visualizing "heads"

P_1' = experiencing "heads"

P_2' = experiencing "tails"

R = some randomly varying pattern, equally dissimilar to P_1, P_1', and P_2'.

The experiment proceeds as follows. The subject visualizes heads for a time a preceding the coin toss. This mental pattern continues for a short time b following the toss, when the subject perceives the outcome of the toss. The experiment continues for an additional time c, during which the subject thinks about (experiences) the outcome of the toss and then lapses into a randomly chosen brain state. The subject maintains the experiencing state for time d if he gets a hit (heads), and for time e otherwise.

The experiment just described can be represented conveniently by the time-track diagram of Figure 5.

Equation (8) then predicts the following psi-influenced probabilities:

$$\bar{p}_1/\bar{p}_2 = (p_1/p_2)\exp \zeta s, \tag{9}$$

where

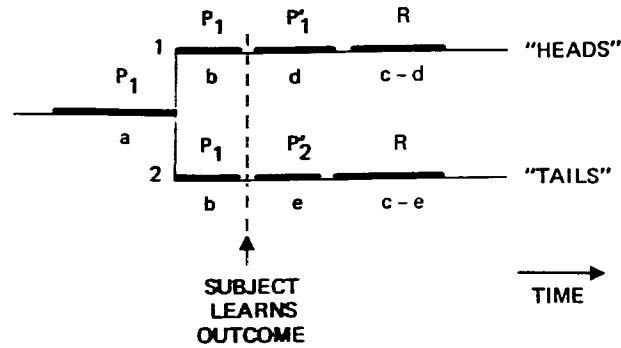$$s = d(\sigma_{11} - \sigma_x) - e(\sigma_{12} - \sigma_x). \tag{10}$$

FIGURE 5   Time-track diagram for an idealized coin-tossing experiment.

The quantities σ are values of similarity computed for the neural patterns of the subject. If $S(A,A')$ denotes the calculated similarity of two arrangements A and A', we define

$$\sigma_{11} = \ln S(P_1,P_1')$$

$$\sigma_{12} = \ln S(P_1,P_2')$$

$$\sigma_x = \ln S(P_1,R).$$

(The similarity associated with the changing position of the coin does not appear in these equations, because the change in S due to the motion of a single object is insignificant compared with that arising from changes in a complex pattern of many particles, as previously discussed.)

To obtain specific numerical values for the σ's requires detailed calculations which lie outside the scope of this article. However, the definition of similarity which we have adopted mirrors our intuitive notion of the concept of similarity; therefore, it is evident that the pattern P_1 will be somewhat similar to P_1', less similar to P_2', and still less similar to R. Thus we may write

$$\sigma_{11} > \sigma_{12} > \sigma_x .$$

Note that the amplitude s of the psi effect in equation (9) determines the nature of the experimental outcome:

$s > 0$ implies positive psi (heads turning up more frequently than expected by chance);

$s = 0$ implies chance results (no psi);

$s < 0$ implies negative psi (psi-missing).

After a little practice, it is easy to write down an expression for s such as equation (10) simply by examining a time-track diagram like Figure 5.

What strategy should the subject use to produce as strong a positive psi effect as possible? The best strategy can be determined by simply varying the experimental parameters to maximize s. What results is the following:

 (i) Maximize the time d (set $d=c$); this implies that the subject should plan to spend as much time as possible experiencing heads if he gets a hit;

 (ii) Minimize the time e (set $e=0$); the subject should plan not to linger or brood over misses;

 (iii) Maximize σ_{11}, i.e., visualize vividly and realistically;

 (iv) If it is not possible to make $e=0$ exactly, make P_1 and P_2' as dissimilar as possible, so that $\sigma_{11} \gg \sigma_{12}$; this suggests the use of rich, complex imagery.

These four conditions define an optimum strategy to maximize the subject's chances of psi success, namely an outcome of heads.

3.3. Example: a generalized psi experiment

Instead of a coin toss, we can let the time-track branching of Figure 5 represent any process with two possible outcomes. For example, if the process is *any* psi experiment, we can let outcome 1 represent psi success and outcome 2 psi failure.

In this case, we adopt a different set of definitions for the subject's brain patterns:

 P_1 = visualizing or anticipating psi success,

 P_1' = experiencing or recalling psi success,

 P_2' = experiencing or recalling psi failure,

 R = randomly varying pattern, equally dissimilar to P_1, P_1', and P_2'.

(If the subject never learns the outcome of the psi experiment, in the present theory there is no psi effect produced by the subject. However, a psi effect could still be generated by the brain patterns of the experimenter or some other observer; this could be treated by redefining P_1, P_1', P_2', and R.)

With the definitions above, equations (9) and (10) hold once again, and the optimum strategy corresponds exactly to that derived in the coin tossing case. The only difference is that the results now apply to any type of psi experiment, or in fact to any event whose outcome is uncertain. In essence, the theory predicts that PK induced by an observer can affect the outcome of *any* random process.

3.4. Example: a sequence of psi trials

Instead of a single psi trial, we more frequently deal with a sequence of trials carried out with the same subject. This sequence may consist of a single run of trials, a series of runs, or a number of separate experiments.

Let us consider a particular coin toss T in a long sequence of tosses and calculate the effect of psi. The target for toss T will be outcome 1 (heads), and outcome 2 (tails) will represent a miss. Future targets in the series (whether chosen yet or not) will be denoted $\alpha, \beta, \gamma, \ldots$, and future misses will be denoted $\bar{\alpha}, \bar{\beta}, \bar{\gamma}, \ldots$ Thus, if $\gamma = 2$ (tails), $\bar{\gamma} = 1$ (heads).

Figure 6 describes the experimental sequence beginning with toss T. The subject's approach is to visualize psi success, so that P_1, P_1', P_2', and R have the same definitions as in the "Generalized Psi Experiment" example. It is assumed that if the current toss is a hit. there will be M_1 further trials with the subject, and otherwise M_2 trials. In a single planned series of tests, we would normally take $M_1 = M_2$; however, it is necessary to consider the subject's entire subsequent history of testing, so that it is quite possible that $M_1 \neq M_2$.

It turns out that when the time tracks arising from an event undergo further

FIGURE 6   Time-track diagram for a sequence of psi trials with target outcomes 1, α, $\beta, \gamma, \ldots$ and non-target outcomes 2, $\bar{\alpha}, \bar{\beta}, \bar{\gamma}, \ldots$

branching in the future. we should weight each future path with its conventional probability (chance expectation) within the integral in equation (3). This fact, plus the assumption that the target outcomes α, β, γ, ... are chosen randomly, allows us to calculate explicitly the net effect of all future branches. The result is that we can replace Figure 6 by an equivalent time-track diagram, Figure 7, which yields the same predictions for the toss T as does Figure 6. In Figure 7, we take

$$f = (d + e)/4 .$$

The psi-affected probabilities for toss T are then

$$\bar{p}_1 / \bar{p}_2 = (p_1 \, p_2) \exp \{ s' .$$

where s' is a simple algebraic expression which can be derived from Figure 7. As before, $s' > 0$, $s' = 0$, and $s' < 0$ correspond to positive psi, chance results, and psi-missing, respectively.

Assume that there is a fixed time g available per trial,

$$g = a + b + c .$$

and that the time delay b before perception by the subject is fixed. We now wish to determine an optimum strategy which maximizes s', by varying a, c, d, and e.

We find that the optimum strategies for the subject to pursue are as follows:

(i) If $M_1 - M_2 \gg 1$, take $c=d=e=0$, which gives

$$s' = (M_1 - M_2)g[\ln S(P_1, P_1) - \ln S(P_1, R)] . \tag{11}$$

This strategy may be characterized as: Don't think about the outcome of previous trials at all — always look ahead to the next trial.

(ii)If $M_1 = M_2$, take $a=e=0$ and $c=d=g-b$, which gives

$$s' = (g-b)[\ln S(P_1, P_1') - \ln S(P_1, R)] . \tag{12}$$
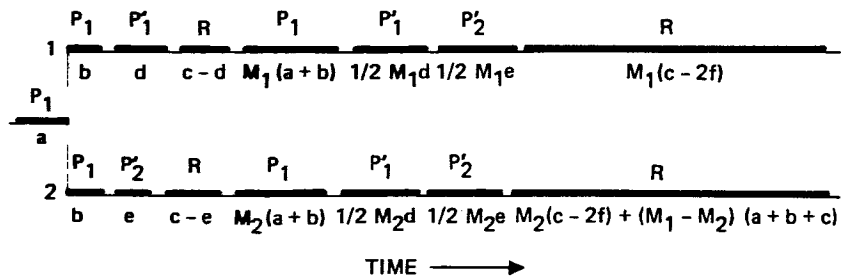

FIGURE 7   Equivalent time-track diagram for the first toss shown in Figure 6.

This strategy may be described as: Spend the available time savouring the experience of successful trials, but don't spend time recalling unsuccessful trials.

Early in the testing of a particular subject, M_1 may be much larger than M_2, because the subject's willingness to be tested, and the experimenter's desire to test him, may be greater if the subject shows psi success in early trials. However, later in testing, $M_1 - M_2$ must decrease to zero, either because an experimental plan is established which pre-determines the number of trials to be conducted ($M_1 = M_2 \neq 0$), or because one of the participants chooses to terminate the testing ($M_1 = M_2 \to 0$).

Equations (11) and (12) show that when $M_1 - M_2 \gg 1$ there can be a considerable enhancement of the amplitude s' of the psi effect, by a factor roughly equal to ($M_1 - M_2$). It is worth noting that this enhancement occurs *only* if the subject's approach is to visualize or anticipate psi success, as in the present example. If the subject is completely disinterested in psi success and instead follows the approach of visualizing heads or tails as in the Coin Tossing example treated earlier, there is no enhancement and in fact the probabilities p_i do not depend upon M_1 and M_2.

The example treated in this section yields some results which apply to other cases as well:

(i)   In general, there are optimum strategies which maximize psi effects, but the nature of the optimum strategy may change as experimentation proceeds. In some instances, the strategy which works best in early testing yields no psi effects at all in later trials.

(ii)   If the experimental design allows early successes to lead to a larger number of psi trials, psi strength can decline dramatically with testing.

3.5. Example: "Inertia of Beliefs"

In the preceding examples, we have assumed that the random event being studied could be physically isolated from the rest of the universe. In practice, complete physical isolation of a psi experiment in time and space is unlikely. However, we can enlarge our definition of the experiment, both in space and in time, to include:

(i)   All patterns of matter which are affected by the outcome of the experiment; and

(ii)   All times during which the state of the universe is sufficiently affected by the outcome of the experiment that $S_i(t_c, t)$ differs significantly from $S_j(t_c, t)$. (That is, after some lapse of time, statistical variations in the universe due to

continued timetrack branching essentially destroy any distinctive patterns arising from the outcome of the experiment.)

This larger experiment, so defined, is not really isolated from the rest of the universe. However, it nonetheless obeys equations (6) and (7), so that we may calculate probabilities using only nearby patterns, according to equation (8).

To be more specific, consider Figure 8, which illustrates a psi experiment which is not isolated from its surroundings. One time track is shown which branches at the psi event, producing outcome 1 or outcome 2. This time track might represent only the patterns of matter immediately associated with the experiment, e.g., the subject plus the experimental apparatus. However, Figure 8 also indicates a second parallel time track, describing the patterns of some additional group of material particles, not considered part of the psi experiment but nevertheless affected by its outcome. In Figure 8, if the experiment has outcome 2, this external pattern changes from P to $\bar{P}$ for a time T.

In the usual case, the patterns along either of the parallel time tracks are more similar to one another than they are to patterns on the other time track. As a result, the similarities S_i^t for the larger experiment (i.e., all of Figure 8) can be written as a product of the similarities computed for each of the tracks separately.

The psi-affected probabilities for the experiment depicted in Figure 8 are then found to satisfy

$$\bar{p}_1/\bar{p}_2 = (p_1/p_2)\exp[\zeta(s+s'')] , \tag{13}$$

where s is the psi amplitude, as previously derived, associated with the psi
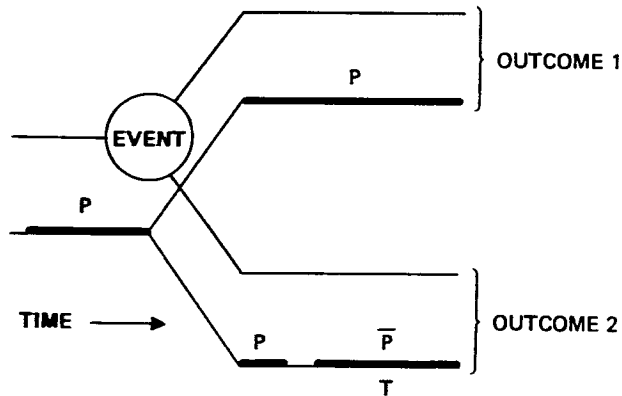

FIGURE 8   Time-track diagram describing a psi experiment, or an event, plus an additional group of material particles with an initial spatial pattern P.

experiment itself, and s'' arises from the external environment:

$$s'' = T[\ln S(P,P) - \ln S(P,\bar{P})] .\tag{14}$$

Thus the external environment can exert a PK-like effect on the outcome of the experiment, and the amplitudes of the psi influences simply add together.

We have created an artificial distinction between the experiment and its environment, although both are simply parts of an overall pattern of matter which is affected by the outcome of the event. However, this distinction is useful, because the parallel time tracks of Figure 8 remind us that the psi amplitudes due to the experiment and due to various portions of its environment can be calculated independently of one another and simply added together. The utility of this approach will be evident in the following discussion.

Suppose that in Figure 8 the external pattern P represents a certain set of beliefs manifested as electrochemical or physical patterns in the brain of an observer 0. P then represents a change in those beliefs, which only occurs if the observed event has outcome 2. Equations (13) and (14) predict that the event will be biased towards the outcome (outcome 1) which leaves 0's belief P unchanged. Although the similarity S_i associated with a belief pattern may well be smaller than that intentionally manipulated in the experiment by the subject's conscious thoughts, the belief pattern may persist for a much longer time T, and this would increase its psi amplitude s'' in equation (14). This amounts to an experimenter or observer influence of the type discussed by Kennedy and Taddonio (1976) and White (1976a, 1976b).

Detailed calculations are necessary, but the foregoing discussion provides a theoretical basis for a number of effects:

Declines in Scoring. We may expect that positive psi results will decline or vanish with repeated testing or with tightened controls; otherwise, the results would become sufficiently convincing to change the belief patterns of critics of psi. (This is a different, and more generally applicable, basis for scoring declines than that previously discussed in the "Sequence of Psi Trials" example.)

Sheep–Goats Effect. It is probable that long-term memories such as belief patterns are encoded at different physical sites in the brain (e.g., at synapses) than are conscious mental states, which are presumably manifested as transient electrochemical changes in dendrites and axons (Sholl, 1956; Eccles, 1973). If so, we may define the psi experiment in Figure 8 as involving only the conscious thought patterns of the subject, letting the subject's belief pattern be treated independently as part of the external environment. Then the considerations above would imply that the subject's beliefs will psychically bias the outcome of the experiment so as to confirm those beliefs; that is, a subject who believes in psi will perceive that he exhibits successful psi, and vice versa. (It is the subject's perception of success which counts, not reality; this could be verified experimentally.)

Unintentional PK. More generally, it appears that *all* events which we experience should be biased towards outcomes which confirm our expectations. That is, if you believe in astrology, or yoga, or health foods, or rationalism, or a specific theory of psi, events will tend towards outcomes which maintain your beliefs. Moreover, if you think positively or optimistically, your outlook will be reinforced by events; this implies that each individual may exert a sort of unconscious PK which tends to influence his everyday affairs. What counts is that a person's perception of events will tend to match his expectations; however, both psychological and psychokinetic effects may occur which distort this perception.

Although these everyday psi effects are certainly predicted by the theory, we have not yet ascertained whether they should be strong enough to be observable. We would have to carry out calculations using some specific model for how beliefs are stored in the brain, and account for the conflicting psi influences generated by different individuals. The difficulty of planning an experimental test of these effects is readily apparent. Nevertheless, it is interesting that such far-reaching predictions are directly implied by the psi theory developed above.

4. PSI-CONDUCIVE CONDITIONS

Let us return our discussion to the laboratory, where we have the best chance to observe psi effects systematically. By applying the theory to examples such as those above, we can derive guidelines which should enhance the probability of success of any psi experiment. These guidelines may be summarized in words as follows:

(i) Choose a not-too-unlikely psi process. (This condition is equivalent to Stanford's requirement that the random event occur in a non-deterministic system; see Stanford, 1978, 205–207.)

(ii) Exclude unsympathetic observers.

(iii) Don't attempt a definitive, convincing demonstration of psi which might make significant changes in people's belief patterns.

(iv) During the test, visualize the desired outcome.

(v) Use complex and vivid (and possibly, unique) imagery.

(vi) Fully experience and recall successes.

(vii) Don't brood over or think about past failures.

(viii) Don't let psi success change your thoughts or actions.

These conditions are interestingly reminiscent of those in the parapsychological literature (although there is controversy regarding the desirability of vivid imagery; see White 1976a, 147, 150 and 1976b, 343; Rao, 1977, 332–333; Reichbart, 1978, 162; Stanford, 1978, 210). Some of these conditions (numbers (ii), (iii) and (viii) run directly counter to what many persons hope for: a definitive, repeatable demonstration of psi. The present theory essentially suggests that sceptics can become convinced of the validity of psi only gradually, if at all.

Detailed calculations of similarity which include background effects caused by terrestrial objects lead to a few additional factors which may be psi-conducive. These are given below for whatever help they may provide, although space does not permit a fuller explanation:

(ix)   Let the subject move around during the experiment.

(x)   Limit each experiment to no more than about one hour.

(xi)   Keep the subject in a calm, or at least unchanged, physical state.

5.   CONCLUSIONS

5.1. Recapitulation

A physical theory of psi has been described which can predict a wide variety of psi phenomena, but without contradicting ordinary physical and mechanical observations. The theory is non-local and non-causal, and thus its acceptance would require a major conceptual change in present-day physics. In principle, the theory gives quantitative predictions of the probability of observing psi in any experimental situation.

According to the theory, every psi experiment is subject to potential paranormal interference by the experimenter, the subject, and even the potential future thought patterns of other persons. As a result, a totally repeatable, convincing demonstration of psi may be impossible. This unreliable behaviour of psi is not a postulate of the theory, introduced ahead of time to excuse psi's elusiveness; it is a natural mathematical consequence of psi's space-independent and time-independent properties. The theory specifies all the parameters which need to be controlled to make psi exactly reproducible upon demand; however, in practice it is difficult to isolate the experiment adequately from the rest of the universe.

5.2. Philosophical implications

Because future patterns play such a large role in determining the probable outcome of an event, it is easy to see that psi processes predicted by the present theory are goal-oriented, not process-oriented. Thus, the performance of a subject in a PK experiment should not depend on how complex an apparatus is used to generate the random event, in agreement with current views (Schmidt, 1975, 314; Schmidt, 1977; Kennedy and Taddonio, 1976, 9-10, 26-27; White, 1976a, 159; Stanford, 1978; see also Foster, 1940). There may still be a causal chain leading to the outcome, and psi will tend to affect the most susceptible links in that chain; however, the particular changes produced by psi in the overall process are directed towards producing a certain outcome rather than towards producing some specific intermediate state. (For example, in the case of macro-PK the eventual outcome is some form of memory or record of the psi event; psi will act to produce this outcome not only by affecting the macro-PK event itself, but also by inducing hallucinations and false memories in observers, and recording errors in mechanical devices.)

A further implication of the theory arises when it is applied to events other than laboratory psi experiments. The theory suggests that every event in the universe is psi-influenced towards an outcome which leads to specific future patterns of matter; in effect, events exhibit intention (McWhinney, 1979). This somewhat teleological aspect of the theory needs further investigation.

5.3. Quantitative verification

If we try to design an experiment to measure the coupling constant ζ in the theory, and to verify the theory quantitatively, it is not obvious that we can control adequately all the variables because of the effects previously called Inertia of Beliefs. However, it may still be possible to verify the present theory by a series of small experiments which don't disturb the universe too much, and by using the theory to analyze regularities and patterns in psi test results: For example, in PK experiments involving N independently acting subjects, if experimenter bias can be minimized, the amplitude s of equation (10) is predicted to increase in proportion to N. It is also worth remembering that there are other sciences, such as cosmology, in which one does not have the luxury of running repeated, controlled experiments.

5.4. Relationship to previous theoretical work

A large number of psi theories have been proposed; although Rao (1977) certainly does not discuss all of these, his framework for classifying various theories is quite useful. In Rao's terminology, the present similarity theory is a physical

model, although it is not causal in the time-ordered sense used in physics, and does not require "a physical connection between the interacting agencies" (p. 301).

The present theory relates most closely to previous work by Schmidt (1975, 1978) and Stanford (1978). Both Schmidt and Stanford regard ESP and PK as resulting from a single psi process, manifested as a biasing effect on otherwise random events. The similarity theory in effect provides an underlying mechanism for such a biasing effect, and predicts its magnitude.

Schmidt assumes the existence of psi sources and draws schematic diagrams to describe experiments rather than the time-track diagrams of this article. However, his concern about external effects, extending even to "the readers of the final research report", agree precisely with our theory. His psi strength θ is directly related to our psi amplitude s:

$$\theta = \exp \int s .$$

The principal difference is that the similarity theory, in effect, derives Schmidt's unspecified psi sources from specific patterns of matter. (In our theory, no stimulus of a psi source is required, and this removes a possible inconsistency between Schmidt and Stanford; see Stanford, 1978, 211.)

In the present theory, a definitive psi demonstration which convinces many people of psi will tend to fail because of Inertia of Beliefs; this corresponds to Schmidt's "divergence problem" (1975, 316–318). However, in the context of our theory, it appears that most psi experiments will simply enter the body of experimental literature and have an effect which is limited both in spatial and temporal extent, tending to remove the divergence.

The relationship between Stanford's work and the similarity theory is less direct. Stanford's basic postulate (p. 208) is that events are biased towards "conformance behaviour," i.e. outcomes favourable to an organism ("disposed system"). Our theory can produce similar effects, in the following sense:

(i) If the organism *visualizes* a desired state, random outcomes will be biased towards future situations in which the organism *experiences* the desired state.

(ii) Random outcomes leading to unpleasant circumstances for the organism should be less likely than chance expectation, since these circumstances occur on time tracks where the organism's internal patterns are altered or destroyed.

To the extent that our theory satisfies Stanford's basic postulate, it provides a way to combine the sometimes conflicting psi effects arising from more than one disposed system, as he requires (p. 209).

5.5. Utility

Although quantitative verification is presently lacking, the similarity theory seems qualitatively very consistent with previously reported psi studies. This theory, or some similar one, should therefore aid in the conceptual design of psi experiments, and provide a useful systematic framework for thinking about and understanding psi phenomena.

Acknowledgements

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