

## 2. Psychophysical Interaction

### The Problem of Psychophysical Interaction

The nature of mind and its relationship to the physical world remains a fundamental mystery. Does mind 'emerge' out of or represent some 'inner' dimension of physical states? Or is mind an independent entity that interacts with but is not reducible to physical states? Is the brain a generator or a transmitter of mind? If the former, what is the magical algorithm through which physical states achieve consciousness? If the latter, what is the mode of interaction between mind and brain? Is the traffic one-way or two-way: are mental states always effects of brain states and never their causes, or are brain states sometimes effects as well as causes of mental states?

The problem of psychophysical interaction, or the "mind-body problem" as it is sometimes called, has traditionally been a problem for speculative philosophy rather than science. Scientific discussions of this topic have generally reflected one or two points of view. One is that the problem is inherently metaphysical, has no empirical consequences, and is therefore outside the domain of science. The other is that psychophysical interaction is a premature scientific problem, one that can only be solved through future developments in the neurosciences. The philosopher of science Karl Popper refers to the latter view as "promissory materialism," and criticizes it on the grounds that it presupposes the form of the solution, i.e., through reduction of mind to currently unidentified physical states, and in so doing, makes claims

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for the neurosciences that cannot be substantiated (Popper and Eccles, 1977).

Among modern neuroscientists, J. C. Eccles (1953) and Wilder Penfield (1975) are perhaps the most outspoken critics of "promissory materialism." Both have advocated dualistic solutions to the problem of psychophysical interaction. Eccles (1953) suggests that the brain is a detector rather than a generator of mind and speculated that 'weak mind influences' could modify the pattern of discharge of hundreds of thousands of neurons via weak effects on neural assemblies specialized in mind-brain communication:

"Thus," says Eccles (1953), "the neurophysiological hypothesis is that the 'will' modifies the spatio-temporal activity of the neuronal network by exerting... 'fields of influence' that become affected through this unique detector function of the active cerebral cortex.

"It will be objected," he continues, "that the essence of the hypothesis is that mind produces changes in the matter-energy system of the brain and hence must be itself in that system.... But this deduction is merely based on the present hypotheses of physics. Since these postulated 'mind influences' have not been detected by any existing physical instrument, they have necessarily been neglected in constructing the hypotheses of physics...." (My emphasis)

Eccles' speculation, while in many ways an advance over earlier dualistic formulations, is based primarily upon negative evidence, i.e., our present inability to identify mind with specific brain processes or structures. In order to bring such speculation into the empirical domain, it would be necessary to have positive evidence of the sort suggested by Eccles in the above quotation, i.e., physical detection of mind influence under conditions that preclude physiological reductionism. Claims of evidence of this sort, and more importantly for our present purposes, of methods for obtaining such evidence, constitute the subject matter of parapsychology.

### Parapsychology

Parapsychology or psi research is the study of interactions between living systems and their environment (including other living systems) that are anomalous with respect to currently-recognized physical channels of information exchange. The interactions are characterized by the acquisition of information from the outside world under conditions prohibiting involvement of known physiological receptors (extrasensory perception or ESP) by the apparently direct influence of mental processes on external physical systems (psychokinesis or PK). Such interactions are generally called psi phenomena.

Experimental evidence for the occurrence of psi phenomena has accumulated over the past fifty years (Rhine, et al., 1940) and has increased particularly during the past decade (Wolman, 1977). The experimental and statistical methods used in this area have survived sustained and penetrating critical examination (Honorton, 1975; Mauskopf, 1979; Mauskopf and McVaugh, in preparation) and are generally well-regarded by behavioral scientists and methodologists (e.g., Barber, 1977; Rosenthal, 1966). Nevertheless, parapsychological research remains controversial.

There are two major reasons for the continuing controversy. By far the most influential has been the consistent failure of psi research to identify physical correlates of the phenomena, indeed, even a plausible physical mechanism for their occurrence. Psi phenomena appear to be distinctly psychological in origin. Whether this view is correct or merely based upon our current ignorance, it has been widely accepted by critics and researchers alike, and has led a number of scientists to reject psi phenomena on a priori grounds (e.g., Hebb, 1951). Although the apparent lack of physical substrates may be philosophically disturbing, this is a dubious basis upon which to reject empirical findings. As Popper and Eccles (1977) point out, the belief that our familiar mental processes are ultimately reducible to physical descriptions is, as yet, unsubstantiated speculation, and until such time as "promissory materialism" is empirically vindicated, we should remain open to alternative possibilities.

The other major reason for continued controversy over the status of psi phenomena is that findings in this area have been difficult to replicate. Replicability implies specification of antecedent conditions associated with the occurrence or detection of a phenomenon. Because of the anomalous features of psi phenomena, much of the research in this area has been demonstration-oriented rather than process-oriented. Demonstration experiments are useful in increasing confidence in the reality of a phenomenon through control or elimination of alternative hypotheses, but they do not illuminate the antecedent conditions in which the phenomenon occurs, and therefore contribute little toward increasing its reliability.

Fortunately, this situation has begun to change, with greater emphasis on process-oriented studies designed to identify psi-antecedent conditions, and as this has occurred, there has been an increase in the replicability (and in some cases, the magnitude) of experimental psi effects. I will illustrate with two sample areas that have been the focus of considerable experimental work during the past decade, and which I believe have both methodological and substantive implications for an empirical approach to the problem of psychophysical interaction.

#### Psi-conductive States

Like other complex psychological processes, psi interactions appear to be modulated by individual differences (Palmer, 1977), emotional and motivational factors (Williams and Duke, 1979), the quality of interpersonal interaction between experimental participants (Honorton, Ramsey and Cabibbo, 1975), and particularly by the internal state of the subject.

Reports of naturally-occurring, spontaneous psi experiences are historically and cross-culturally linked to dreaming, hypnosis, and meditation. Between 50-65% of the reported spontaneous ESP experiences have been dream-mediated (Green, 1960; Prasad and Stevenson, 1968; Rhine, 1962; Sannwald, 1959). Mental imagery is the dominant mode of psi expression: only 15-30% of the spontaneous cases involve imageless impressions (Stevenson, 1976).

Anecdotal accounts of apparent psi phenomena recur frequently in the early literature of hypnosis and meditation. Psi phenomena were widely regarded as the "higher phenomena of hypnotism" until late in the nineteenth century (Dingwall, 1967). Similarly, in traditional meditation techniques, psi effects or siddhis were claimed to be natural by-products of a state of abstraction in which there is a diminution of ego-boundaries and self-object differentiation (Mishra, 1971).

Controlled laboratory experiments support the claim that dreaming, hypnosis, and meditation are psi-conductive states. Experiments in which subjects have been tested for ESP in these states show stronger and more reliable ESP effects than those obtained in studies where subjects performed ESP tasks in their ordinary "waking" state. A recent survey of all experiments performed in this area through 1976 shows significant overall ESP effects in 49 of the 87 experiments reported (Honorton, 1977). This is a 56% success rate, compared to the chance expectation of 5%. Comparable findings have been reported by 17 of the laboratories contributing to this data base.

During the past decade, a growing research effort has been directed toward identification of antecedent conditions of psi-conductive states. Part of this work has been guided by a provisional model that considers psi-conductive states to be internal attention states (IAS), characterized by the following conditions shared by classical psi-conductive states: (1) muscular relaxation, (2) reduced sensory input/processing, (3) sufficient cortical arousal to sustain consciousness in the absence of sensory input, (4) increased vividness of or attention to spontaneous mental processes, and (5) a communication goal or need to communicate (Honorton, 1977; 1978a).

According to the IAS model, these conditions serve to increase the detectability (but not necessarily the availability) of psi input through attenuation of competing proprioceptive and exteroceptive stimuli that ordinarily mask weaker psi input. In other words, normal perceptual processes constitute sources of noise with respect to psi input. When sensory input is decreased, there is increased attention to internal processes,

especially imagery, which seems to be a primary mode of encoding psi input. The mediation of weak inputs through mental processes has been demonstrated in studies of subliminal perception (Dixon, 1971). Like psi phenomena, subliminal influences appear to be more readily detected when mediated through internal attention states, are sometimes associated with significant avoidance of the target, i.e., "perceptual defense," and seem to display physically anomalous characteristics, e.g., subliminal retrieval rate appears to be inversely related to the physical stimulus energy.

Several experimental procedures have been developed to test these conditions. One such procedure involves a mild form of perceptual isolation called ganzfeld stimulation to reduce sensory functioning and to increase the subject's attention to internal imagery and thought processes (Bertini, Lewis, and Witkin, 1964). Seated comfortably in a sound-attenuated room, the subject relaxes as his visual and auditory input is regulated to provide a constant, unpatterned perceptual field. The subject is asked to "think out loud," in order to describe a randomly selected target picture that is located in another room. He is instructed not to dwell upon the target, but rather to allow it to emerge spontaneously through his ongoing mental processes.

In 'telepathy' versions of this experiment, the target picture is viewed by a sender (Honorton and Harper, 1974). In 'clairvoyance' versions, the target picture is enclosed in an opaque envelope and its content remains unknown to anyone until the end of the experiment (Schmitt and Stanford, 1978).

Objective evaluation of correspondences between target pictures and subject descriptions is accomplished on a blind basis, following one or two basic procedures. The most common procedure has been to test the subject's ability to recognize the actual target picture from among several alternatives presented to him at the end of the experiment. Here, e.g., the subject is shown four different pictures--the actual target and three controls--and is asked to rank each picture in order of its similarity to his own description. Since the target pictures are randomly selected

(with replacement), the probability that the subject will correctly select the actual target in any given session is one quarter and the result a series of sessions is evaluated by a straightforward application of the binomial expansion.

The other method of evaluating target-mentation correspondences has been to use a special set of target pictures characterized by the PRESENCE/ABSENCE of content in each of ten categories (Honorton, 1975). The content of each target picture is described by a 10-digit binary number. For example, a picture containing elements of content in each of the ten categories is 1111111111 while a blank target, with no content at all, is 0000000000, etc. To ensure statistical independence of the categories, this target set contains one picture representing each of the 1024 possible combinations of the ten categories. At the end of the experimental session, the subject codes his ganzfeld mentation in terms of the PRESENCE/ABSENCE of content in each of these same categories. The subject's coded description is then matched against the target code and since the target elements are statistically independent, this constitutes ten independent binary trials.

With either method, in order to preclude sensory cues, the experimenter as well as the subject is blind to the target content until completion of the ranking or coding procedure.

A detailed summary of the psi ganzfeld work through 1977 has been reported elsewhere (Honorton 1978a). To date, thirty-two experiments of this type have been reported by investigators in thirteen different laboratories. This data base now comprises well over 1,000 experimental sessions contributed by more than 500 subjects. Overall significant ESP effects have been obtained in sixteen of the thirty-two experiments (56%) and by eight of the thirteen laboratories (62%). This is a moderate level of replicability by behavioral science standards.

Statistical summaries do not convey the qualitative richness of this material. Subject's ganzfeld descriptions of remote targets frequently give striking correspondences. The following excerpts from our studies at Maimonides Medical

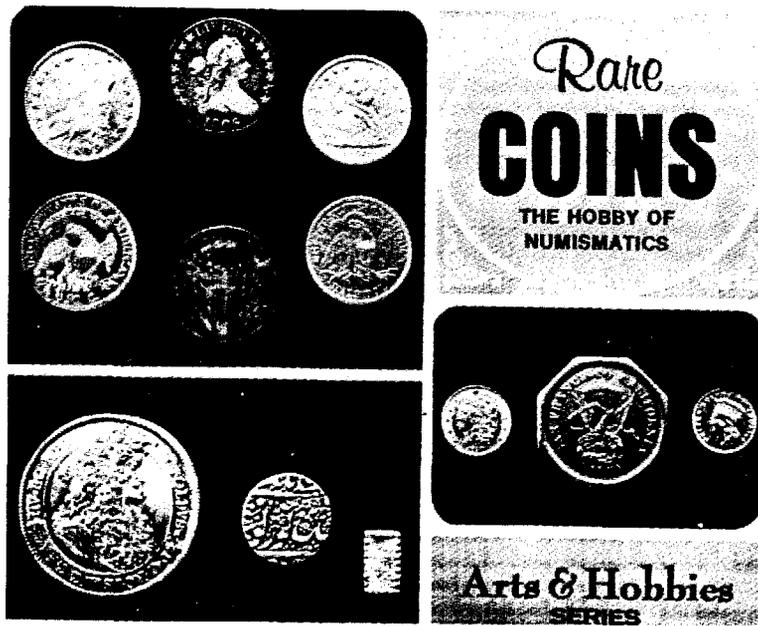


Figure 1.



Figure 2.

ter illustrate the better quality correspondences we have observed with this procedure.

Example 1. (Terry and Honorton, 1976).  
 "...now I see circles--an enormous amount of them. Their sizes are not the same...some are really large, and others are very tiny--no larger than a penny. They just keep flashing in front of me--all these different sized circles.... Now I see colors--a complete array of colors. Two in particular--gold and silver seem to stand out more than all the others...I sense something important I can't tell what, but I get a feeling of importance, respect, value." (Fig. 1)

Example 2. (Terry and Honorton, 1976).  
 "...an archbishop's hat. Tiny people, far away... Floating...a 3-D statue of a girl's face, with short dark hair.... A blue sky, people with umbrellas, looks like it could be France.... Red Riding Hood. A little girl in a bonnet.... Arches. A church.... An aerial view, moving to the ground fast...." (Fig. 2)

Example 3. (Smith, Tremmel, and Honorton, 1976). "...I see a man with a halo. Cherubs in the top left-hand corner. A tapestry hanging from a wall.... A Dutch girl, a native of Holland.... There are definitely two halves of this picture. I see an Amish girl or a Quaker girl...." (Fig. 3)

Example 4. (Smith, Tremmel, and Honorton, 1976). "...See shoulders and an arm. Scales of Libra or Justice.... Two little eyes shining. Two eyes...a face like a baboon looking at me very close. Monkeys swinging by their tails from the trees. Spider monkeys... Two faces looking at each other. See my own eyelashes very clearly..." (Fig. 4)

A number of studies highlight various aspects of the ganzfeld experience in relation to psi performance. Subjects report a variety of unusual experiences during ganzfeld stimulation, e.g., a reduced sense of separation between self and environment, an awareness of being connected to a larger whole, and a change in subjective time-sense. What makes these subjective reports of significance is that they correlate significantly with objective measures of ESP success. Studies



Figure 3.

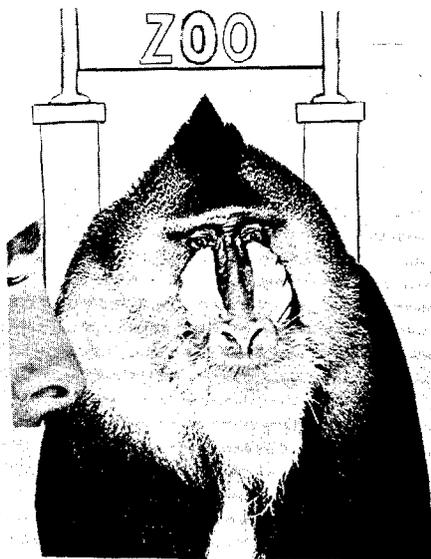


Figure 4.

in several different laboratories indicate that success in the ganzfeld is significantly related to changes in subjective time-sense, body image, and other subjective factors (Braud, Wood, and Braud, 1975; Stanford and Neylon, 1975; Palmer, Bogart, and Tart, 1977).

There is evidence linking the success or failure of psi ganzfeld experiments to the duration of exposure to ganzfeld stimulation. It is known that sensory habituation (de-afferentation) requires approximately twenty minutes of exposure to the ganzfeld (Cohen, 1957). Successful psi ganzfeld studies, with overall significant ESP effects, have averaged thirty-seven minutes of ganzfeld stimulation, compared to an average of twenty-two minutes for the unsuccessful studies (Honorton, 1976). This finding has recently been confirmed (Ashton, et al., in press).

This brief summary has just skimmed the surface of one of several productive lines of research with internal states procedures. A more detailed review of the ganzfeld work, with references to the original research reports, is available elsewhere (Honorton, 1978a). For a review of similar work on the effects of relaxation on psi performance, see Braud (1978).

#### Psychokinesis Experiments with Random Generators

A number of methods have been used over the years to test the hypothesis that mind can directly influence external physical systems (Rush, 1977). Another promising area of psi research, and one with special implications for the problem of psychophysical interaction, involves PK experiments with electronic or quantum mechanical random generators.

These devices use fundamentally random processes such as radioactive decay or the noise in semiconductors to provide an electronic analog of "coin flipping." In a typical device of this sort, electrons emitted by Sr-90 decay trigger a Geiger counter and the momentary position of a high-speed binary counter at the time of the electron registration determines whether "heads" or "tails" are generated (Schmidt, 1970a). These devices can r

domly generate the equivalent of 10, 100, or even 1,000 "coin flips" per second, while at the same time automatically recording the total number of events generated and their "heads"/"tails" distribution.

Subjects observe the current physical state of the device through a feedback signal that occurs whenever the device is in, say, the "heads" state, with no—or different—feedback when it is in the "tails" state. The feedback display may be a digital readout, a light or tone, or a computer graphics display which changes as a function of the momentary physical state of the random generator. The subject's task is to observe the feedback display and attempt to mentally "bias" the normally random output of the device according to preset experimental instructions. The behavior of the device under these conditions is compared to its behavior in control conditions without subjects present or intended influence.

The first experiments of this type were reported by Schmidt (1970b). The feedback display was a circle of nine lamps which lit one at a time in either the clockwise or counterclockwise direction, depending on which of the two states was randomly generated on a given trial. The fifteen subjects in this experiment completed more than 30,000 individual trials. Extensive control runs were also taken in the absence of subjects or attempts to influence the device. While these control runs conformed closely to the expected chance distribution, the experimental trials with subjects deviated significantly from the expected chance values.

Since this line of research was inaugurated, approximately five dozen experiments of this type have been reported by investigators in eight different laboratories. Approximately 65% of these studies yield significant departures from chance under experimental conditions (i.e., with subjects present attempting to influence the device). None of these studies show similarly significant results in control conditions without intended influence (Honorton, 1978b; Stanford, 1977).

These effects, like those studied in biofeedback, appear to be goal-directed. The subject's

task is to increase the frequency of a feedback signal. He need not know or be concerned with what is "inside the box," that is, the internal mechanism of the random generator, in order to influence its output. This is suggested by studies in which key physical parameters of the device have been systematically varied, e.g, when the feedback display observed by the subject is, without his knowledge, switched between two internally different random sources with no difference in the subject's ability to influence the outcome (Schmidt and Pantas, 1972).

Several experiments in our laboratory bear on the apparent goal-directedness of PK from a different direction. We have used a random generator that automatically alternates the definition of the target between "heads"/"tails" one microsecond prior to each trial (May, 1976). This alternating target bit was originally incorporated as an additional precaution, to cancel out any systematic side bias in the output of the device and it has served this function quite well: in seven million control trials, the overall deviation was within 0.03 standard deviations of the expected chance value. In several experiments (Honorton and May, 1976; Honorton and Winnett, 1977; Winnett and Honorton, 1977) subjects attempted to mentally influence the directional output of the device so as to produce above chance deviations on some runs ("high-aim") and below chance deviations on others ("low-aim"). Significant directional effects were obtained in each of these experiments. The fact that the target was defined one microsecond in advance of each trial would appear to preclude any reductionistic interpretation of these effects, since this operation is approximately three orders of magnitude faster than human nervous system functioning, which operates on the order of milliseconds.

Several recent studies have shown a significant relationship between random generator PK effects and specific imagery strategies employed by subjects (Morris, Nanko, and Phillips, 1979). Subjects exerted significant influence on the output of the random generator when they employed a goal-directed strategy in which they focused on the de-

Psychophysical Reality Testing

The problem of psychophysical interaction has remained in philosophical limbo only because it has been empirically inaccessible. In this paper I have reviewed two areas of psi research that may contribute to the development of an empirical approach to this fundamental problem. I believe that the methods and findings of psi research provide science with a unique opportunity to bring this problem into the empirical domain.

The internal states work suggests that when the normally restrictive filtering functions of the nervous system are bypassed or reduced, as in dreaming, ganzfeld stimulation, etc., sensorially-remote information may be acquired in an objectively verifiable manner. ESP falsifies the Aristotelian dictum that all valid knowledge is mediated through the senses.

The empirical viability of dualistic theories of mind/brain interaction, such as that of Eccles, is contingent upon evidence that mental processes are causes as well as effects of physical processes. Experimental evidence for PK is now sufficiently extensive to require at least tentative consideration of the hypothesis that goal-directed mental activity can produce small but measurable changes in the normal operation of external physical devices. While "promissory materialism" could be extended to cover the anomalies studied in psi research, it should be noted that psi phenomena and, indeed consciousness itself, are only anomalous within a framework that assumes all of reality must be reduced to physical principles. The lack of such reducibility is not only consistent with dualistic formulations, it is required by them.

Clearly, any conclusions at this stage would be premature. For myself, I make no stronger claim for parapsychological research than this: for the first time in the history of science, we have begun to forge an empirical approach to one of the most profound and ancient of mysteries, the nature of mind and its relationship to the physical world. We have no answers, but we have begun to develop methods that enable us to ask different kinds of questions.

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### 3. Experimental Psi Research: Implication for Physics

#### Abstract

Experimental laboratory work continues to provide evidence for the existence of so-called psi processes, a class of interactions between consciousness and the physical world as yet unexplained. These include (1) the acquisition of information not presented to any obvious sense, and (2) the production of physical effects not mediated by any obvious mechanism. At SRI we have concentrated primarily on the former, investigating a phenomenon we call "remote viewing," the ability of certain individuals to access and describe, by means of mental processes, information blocked from ordinary perception by distance or shielding.<sup>1-6</sup> Our data base consists of more than 100 experiments in the remote viewing of targets ranging from objects in nearby light-tight canisters to geographic sites at transcontinental distances, viewed from locations which include shielded Faraday cages and a submerged submarine. Data from these observations indicate that models put forward to explain psi processes must account for bit rates on the order of 0.1 bits/s, resolution of approximately 1 mm, apparent ineffectiveness of ordinary electrical shielding, and relative insensitivity to distance up to at least 10,000 km.

Although such phenomena might appear to be in conflict with the laws of physics, we anticipate that with further work much of the data will be accounted for either within the framework of physics as presently understood, or on the basis of extrapolations that have been proposed to account for other (non-psi) data, and that, converse