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Engineering Anomalies Research

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Abstract—Anomalous consciousness-related phenomena of possible relevance to basic physical science and modern engineering practice are addressed experimentally and theoretically in an effort to identify those devices, systems, and processes most likely to display operator-related anomalies in their performance. and to illuminate the characteristics of such aberrations. Three interrelated sectors of effort are pursued: the design, implementation, operation, and interpretation of experiments in low-level psychokinesis; the development of analytical methodologies for quantitative assessment of precognitive remote perception data; and the development of theoretical models useful for correlation of the experimental data, design of better experiments, and explication of the phenomena on fundamental grounds.

The primary effect observed in the psychokinesis experiments is a marginal but replicable shift of the mean of output count distributions with respect to empirical baselines or theoretical expectations, with no discernible alterations in any higher moments. Over large data bases, these mean shifts can compound with considerable statistical regularity to high levels of significance, depending on the particular operator, the direction of effort, and other prevailing experimental conditions. In many cases, individual operator "signatures" of achievement are found to transfer across various experimental devices, including some driven by deterministic pseudo-random sources.

Quantitative analysis of a large data base of remote perception experiments reveals similar departures from chance expectation of the degree of target information acquired by anomalous means. Digital scoring techniques based on a spectrum of 30 binary descriptors, applied to all targets and perceptions in the experimental pool, consistently indicate acquisition of substantial topical and impressionistic information about remote geographical locations inaccessible by known sensory channels. The degree of such anomalous information acquisition appears independent of the spatial separation of the percipient from the target, up to global distances, and also independent of the temporal separation of the perception effort from the time of target specification by the agent, up to periods of precognition or retrocognition of several days.

In an attempt to illuminate these empirical results, a theoretical model has been proposed that invokes quantum mechanical metaphors to describe the interaction of consciousness with its environment. By representing consciousness by quantum mechanical wave functions and its physical environment by appropriate potential energy profiles, Schrödinger wave mechanics

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may be used to define eigenfunctions and eigenvalues indicative of psychological and physical experience, both normal and anomalous, in a form applicable to the experimental designs.

The experimental results in hand, along with the generic predictions of the theoretical model, suggest numerous short and longer term practical applications of the phenomena, and raise basic issues about the role of consciousness in the establishment of reality.

Introduction

Scholarly research into a broad range of anomalous consciousness-related phenomena over the past century has produced an array of provocative results, but none that can be regarded as fully convincing in the traditional scientific sense. Nor has this research yielded sufficient empirical correlations to support any existing category of theoretical model for description and comprehension of such effects, let alone to refine such models to functional utility. Nevertheless, the potential implications for many fields of human endeavor are sufficiently profound and pervasive that efforts for demonstration and resolution continue in several disciplines. Among these, the various fields of engineering science are neither immune from the implications nor impotent to contribute to the search. Throughout its three major domains of modern activity—the processing of energy, of materials, and of information—engineering engages a multitude of physical devices, systems, and situations that may be potentially vulnerable to such anomalous interactions. In particular, those involving sensitive man/machine interfaces, low-level signal processing units of the microprocessor genre, elaborate data-storage systems, devices utilizing random or pseudo-random noise sources, and very large-scale integrated circuits would seem to merit attention.

The research reported herein consists of three components, conceptually distinct, but in practice interrelated. The first is an ensemble of experiments in low-level psychokinesis—the interaction of human consciousness with some physical device, system, or process resulting in statistical behavior different from that expected on the basis of known science. The second addresses the process of precognitive remote perception—the acquisition of information about geographical targets remote in distance and time and inaccessible by any known sensory means. The primary interest here is the development of analytical methodologies for quantitative determination of the degree of information obtained by such processes. The third segment is an effort to develop a theoretical model to support the experimental program and provide some insight into the basic nature of the phenomena.

Particular experiments have been selected for their immediate and longer term relevance to the practice of modern engineering science, and for their amenability to controlled and systematic laboratory study. Physical and technical parameters are the primary concern throughout; systematic investigation of psychological or physiological correlates is secondary to the accumulation of very large data bases by a relatively small number of participants. All operators are anonymous volunteers, none of whom claims extraordinary abilities, and no screening, training, or induction techniques are employed.

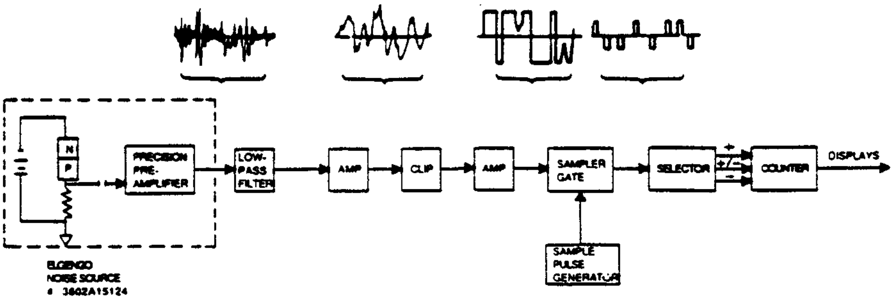
Psychokinetic Interactions With Random Physical Systems

The several experiments in low-level psychokinesis (PK), although diverse in character and scale, all embody some type of random physical process whose distribution is established empirically and, when possible, theoretically. Various human operators then attempt to distort those distributions in prestated directions. To guide them in that task, each experiment provides some form of feedback, usually a visual display, that tracks the degree of shift from the baseline distribution.

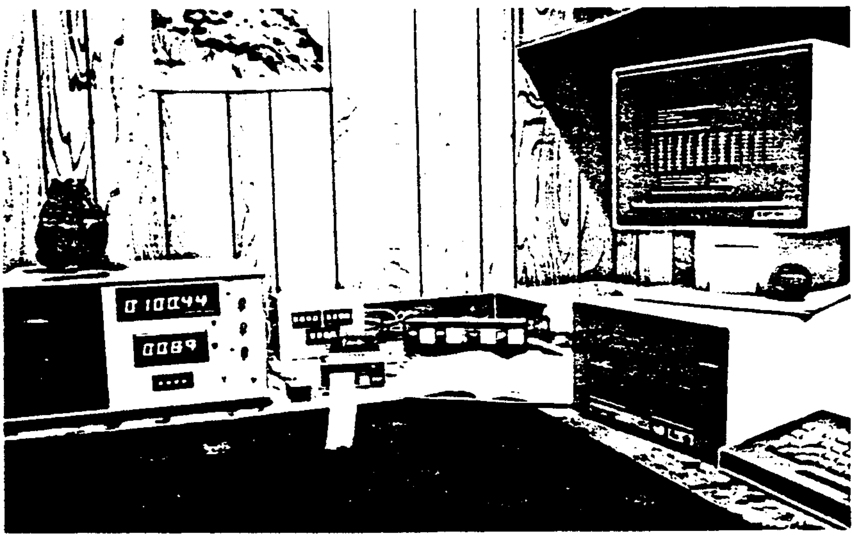
One such experiment belongs to a genre of random event generators (REG) widely used in contemporary studies of this class of phenomena (Krippner, 1977; Radin, May, & Thomson, 1985; Schmidt, 1970; Stanford, 1977). The particular device employed in this program is based upon a commercial microelectronic noise source whose output is transcribed by appropriate circuitry into a random train of positive and negative pulses, suitable for sampling and counting [Fig. 1(a)]. For most formal experiments, the device is set to generate "trials" of 200 pulses each at a rate of 1000 per second, and to count and display the number of those pulses which conform to the regular alternation: +, −, +, −, +, −, etc. Various display and recording units show the operator the results of the counting and insert them on-line into a digital database and computational system.

Figure 1(b) shows the experimental arrangement as seen by the operator, who sits a few feet from the device and its supporting equipment, for example, a computer terminal, a strip printer, and various fail-safe counters that guarantee the integrity of the data. The operator attempts to influence the process to produce a higher number of counts (PK^+) or a lower number of counts (PK^-), or to generate a baseline (BL), in accordance with pre-recorded intentions. In the protocol followed for the largest subset of our data base, data are generated in "runs" of 50 trials, accumulated in "sessions" comprising a minimum of five runs. While session lengths are left to the preference of the operator, a complete experimental "series" requires a full 7500 trials, or 50 runs in each of the three directions of intention. (A few early series consisted of 5000 trials, or 100 runs per intention.) To preclude any artifactual bias, the protocol requires the operator to intersperse sequences of each of the three intentions, PK^+, PK^-, and BL, with all other experimental conditions held constant.

An example of the type of data obtained in this experiment is shown in Fig. 2(a) as a distribution of scores for some 5000 baseline trials (i.e., one million pulses, or bits) taken by one operator, superimposed on the theoretical Gaussian approximation to the appropriate binomial statistics. With reference



(a) REG FUNCTIONAL BLOCK DIAGRAM



(b) REG EXPERIMENTAL ARRANGEMENT

Fig. 1. Random Event Generator.

to the same theoretical distribution, Fig. 2(b) displays the results of the same operator's efforts to shift this distribution toward higher or lower numbers of counts over the same number of PK^+ and PK^- trials, and Fig. 2(c) shows the best Gaussian fits to these data. The effects found in this experiment are usually confined to such marginal shifts of the mean of the distribution, with no perceptible changes in the standard deviation, higher moments, or other characteristics of the distribution.

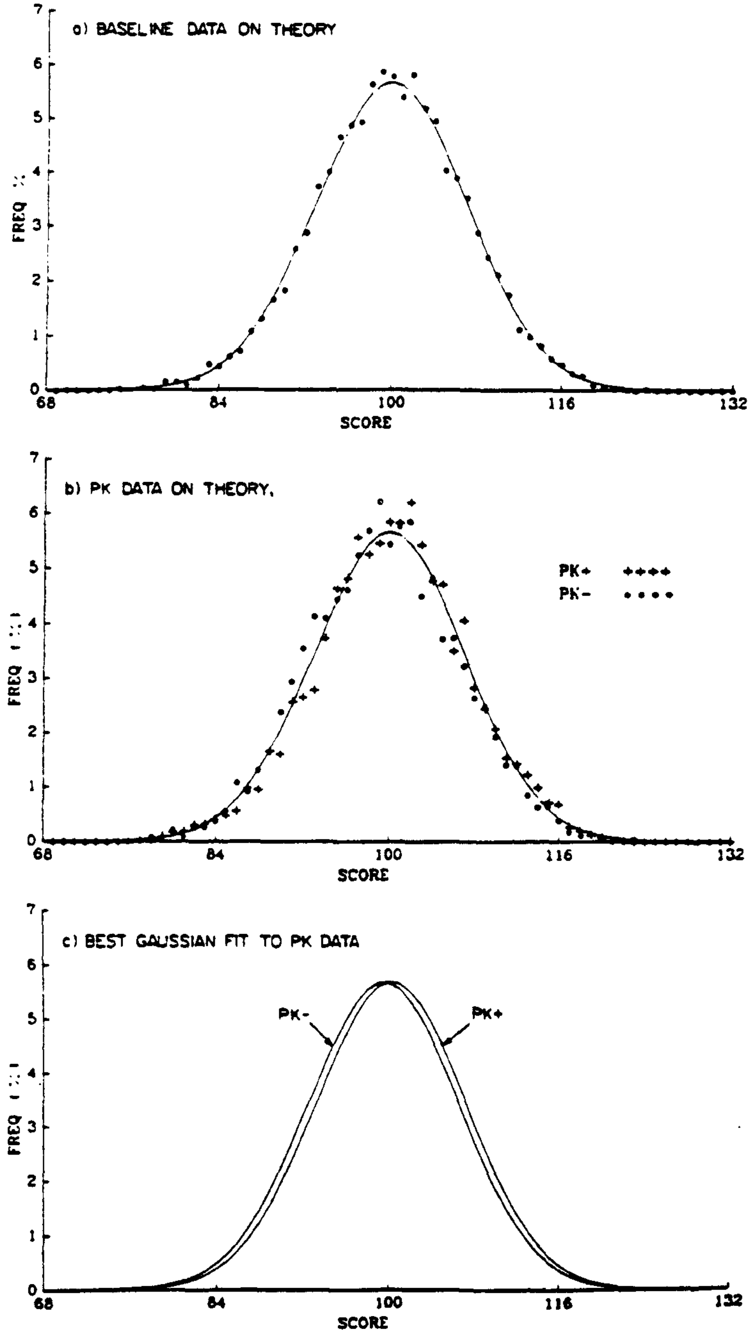


Fig. 2. REG frequency-of-count distributions.

To track the consistency of these small shifts of the mean and to display their statistical significance as a function of the data base size, the accumulated deviation of the counts from the chance mean are graphed as a function of the number of trials processed. Figure 3 employs the same data as Fig. 2, in such cumulative deviation plots for each of the three intentions of the operator relative to the theoretical mean. All three experimental traces display the stochastic variations to be expected in this sort of random process, but whereas the baseline curve meanders close to the theoretical expectation, the PK$^+$ and PK$^-$ traces display almost linear systematic deviations from the chance mean that compound to progressively larger values as the number of trials accumulates. The dashed parabolas are the loci of the five percent chance expectation of reaching that accumulated deviation at that number of trials, and the scale at the right indicates the range of terminal chance probabilities. The terminal values of the means of these PK$^+$ and PK$^-$ data, 100.264 and 99.509 respectively, differ from chance expectation by several standard error units, with the composite achievement unlikely by chance to the order of 10^{-6}.

Such cumulative deviation graphs are found to be quite operator specific and hence are referred to as "signatures." Figure 4 shows such signatures for a few of the many other operators working on this same experiment. Some operators achieve PK results in only one direction, some in neither, some in both, and some show inverted results. The PK$^+$ and PK$^-$ achievement patterns for a given operator are typically asymmetrical, and are often found to be dependent on the conditions under which the operator is performing the experiment, such as the pulse counting rate, whether each trial in the run is initiated manually or automatically, or whether the operator chooses or is randomly assigned the direction of effort. For example, Fig. 5 displays the sensitivity of one operator's performance to the "volitional" and "instructed" modes of data generation. In the volitional mode, the operator chooses the

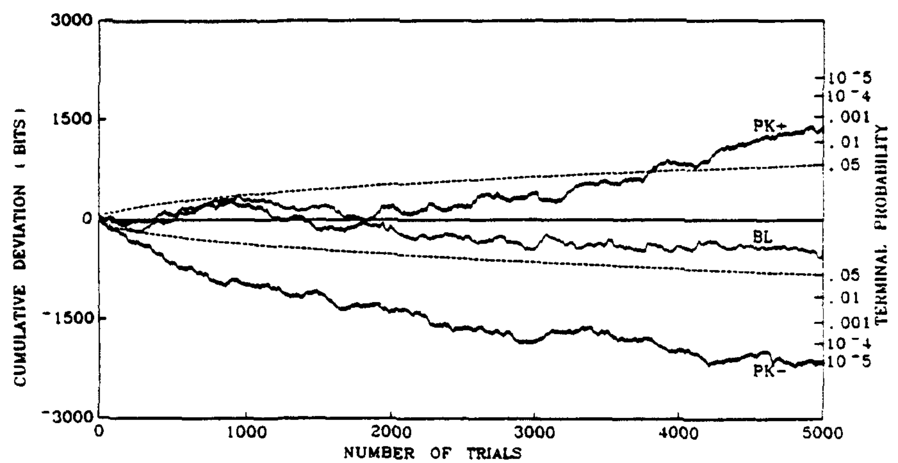


Fig. 3. REG cumulative deviations from theoretical mean.

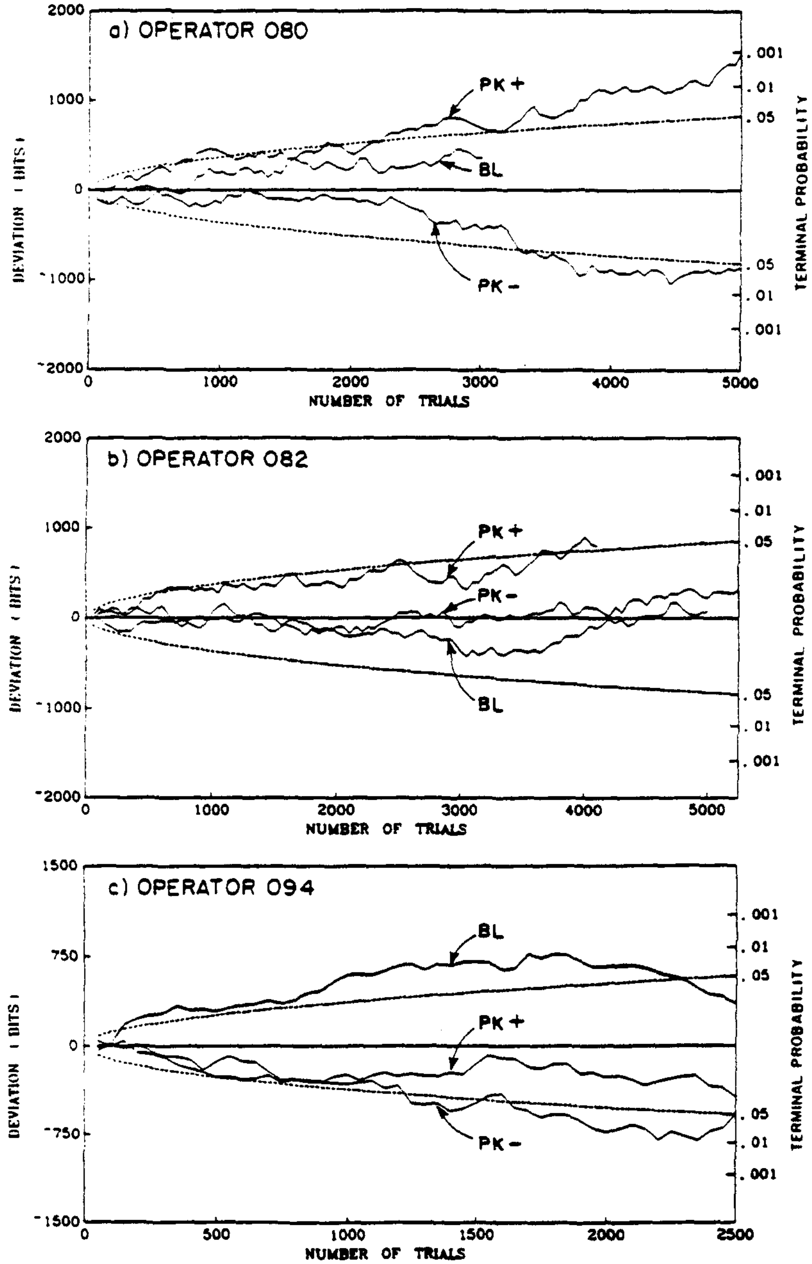


Fig. 4. REG cumulative deviations from theoretical mean: Various operators.

direction of effort and completes five runs (250 trials), or some multiple thereof, before changing the intention. In the instructed mode, a random number generated before each run assigns the direction of effort. Note that in the case

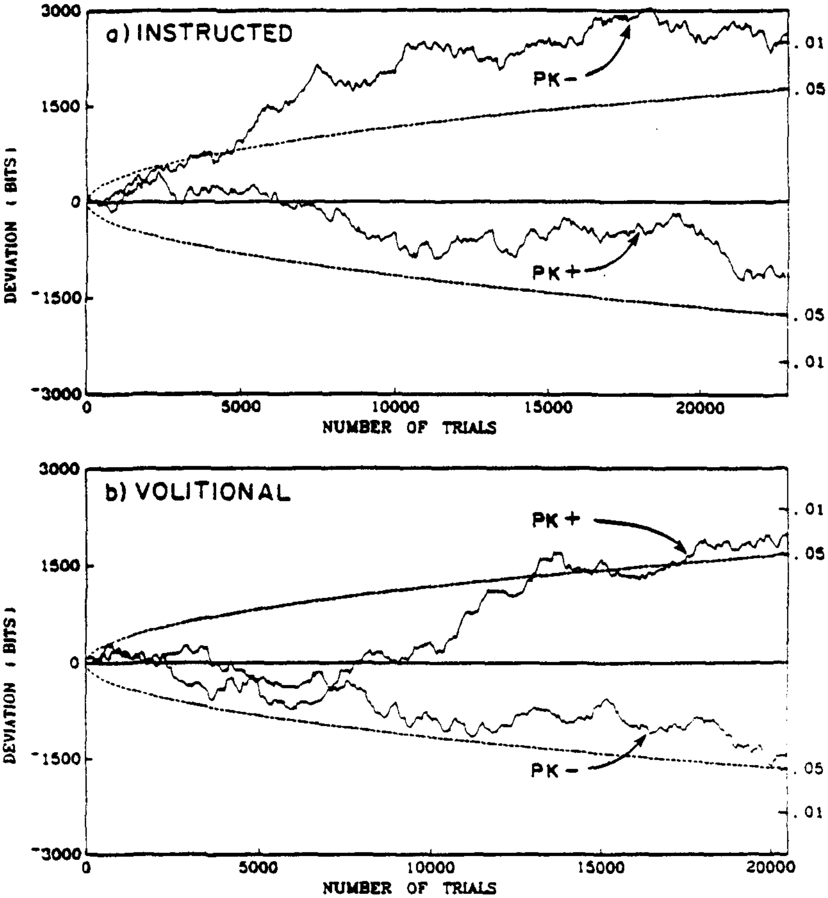


Fig. 5. REG cumulative deviations from theoretical mean: Instructed/volitional (operator 55).

shown, the PK⁺ and PK⁻ results are essentially reversed, that is, those in the instructed mode are opposite to the operator's intention. A complete graphical and statistical compendium of operator signatures and their dependence on such parameters is available in a technical report (Nelson, Dunne & Jahn, 1984).

Despite these variations in individual operator performance and in their secondary dependence on experimental conditions, the overall REG data base also displays a significant statistical trend. Figure 6 and Table 1 show the combined results of the entire formal data base, comprising 87 completed series, and totalling over 250,000 trials per intention (>150 million bits). These data were generated by 33 different operators on two different machines over a period of approximately seven years. Again, the grand baseline mean remains close to the theoretical value, and the PK⁺ and PK⁻ data, despite

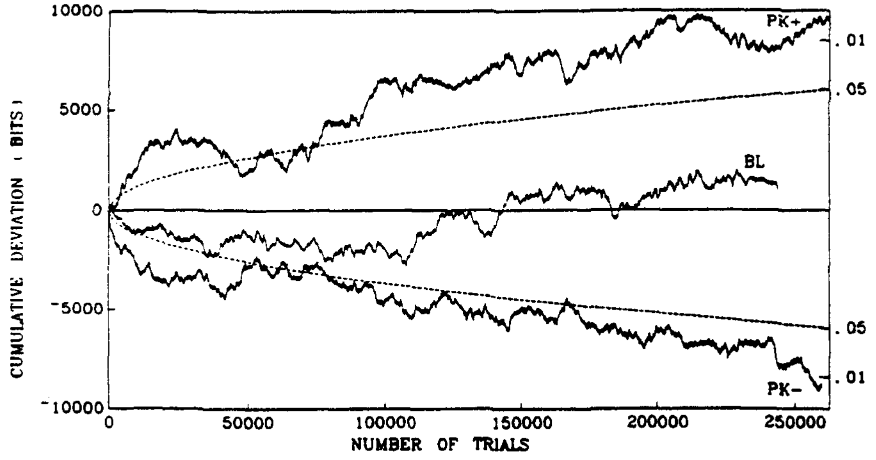


Fig. 6. REG cumulative deviations from theoretical mean: All data, 33 operators.

occasional reversals associated with particular operators and conditions, trend toward increasingly significant deviations in their stated directions. The probability of the indicated overall result occurring by chance is less than 2×10^{-4}.

Other instructive features of the overall REG data base appear in the distribution of terminal scores of the complete series. For example, Fig. 7 shows histograms and analytical fits of all 87 series z-scores for PK^+, PK^-, and baseline efforts. While the mean values of these three distributions are consistent with the terminal values of the cumulative deviation traces of Fig. 6, it is notable that the distributions of the PK^+ and PK^- series scores both have larger than expected variances, at significance levels of 0.06 (PK^+) and 0.01 (PK^-). Conversely, the distribution of baseline series scores is substantially compacted around the theoretical mean and totally devoid of any scores outside of the one-tailed significance criterion, $z > \pm 1.645$. The corresponding reduction in the variance of the baseline score distribution is significant at $p = 0.01$. Recalling that baseline data are generated under conditions identical to the PK series, save for the absence of a stated directional intention on the part of the operator, one is led to hypothesize that a conscious or unconscious motivation to achieve a "good" baseline may actually produce a third PK condition that entails an anomalous constriction of the distribution of scores. This issue is discussed in greater detail in a technical report (Jahn, Nelson, & Dunne, 1985).

Experiments such as these inevitably raise the question of the focus of the interaction between the consciousness of the operator and the machine. In particular, it is reasonable to ask whether the physical behavior of the noise source itself is affected during the PK efforts, and if so, in what way. One obvious strategy for addressing this question is to replace the source unit by other elements and compare results. Several similar microelectronic noise

TABLE I
REG data summary by operator

	PK⁺							PK⁻					
Opr.	# Series	# Trials	Mean	*z*-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$	# Trials	Mean	*z*-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$
10	15	55,100	100.082	2.729	.003	3	12	55,050	99.896	−3.459	3×10^{-4}	4 (1)	13
14	3	8,000	100.070	0.885	.188	1	2	7,800	99.872	−1.603	.054	1	3
16	3	7,500	100.070	0.856	.196	—	2	7,500	99.763	−2.903	.002	1	3
19	1	2,950	100.030	0.232	.408	—	1	2,800	100.042	0.313	(.377)	—	—
20	3	7,550	100.087	1.064	.144	—	2	7,450	99.979	−0.262	.397	—	2
21	1	2,700	100.044	0.321	.374	—	1	2,300	100.156	1.056	(.146)	—	—
29	1	2,500	99.912	−0.625	(.266)	—	—	2,500	100.046	0.322	(.374)	—	—
30	2	5,000	100.026	0.262	.397	—	1	5,000	99.939	−0.606	.272	—	2
33	1	4,000	99.868	−1.178	(.119)	—	—	2,500	99.928	−0.512	.304	—	1
36	2	5,000	99.978	−0.218	(.414)	—	1	5,250	100.068	0.695	(.244)	—	1
41	5	13,450	100.023	0.373	.355	—	3	15,050	99.984	−0.273	.392	— (1)	4
42	1	2,700	100.094	0.691	.245	—	1	2,300	100.031	0.212	(.416)	—	—
44	2	5,300	99.781	−2.255	(.012)	— (1)	—	6,200	99.918	−0.914	.180	—	2
49	2	4,950	99.871	−1.284	(.099)	—	—	5,050	100.072	0.722	(.235)	—	1
53	3	7,550	99.937	−0.778	(.218)	— (1)	1	7,450	99.981	−0.236	.407	—	2
55	13	43,300	100.018	0.544	.293	2 (1)	7	43,400	100.028	0.818	(.207)	— (1)	5
59	2	5,100	100.046	0.461	.322	—	1	3,900	99.923	−0.684	.247	—	2
64	2	5,500	99.940	−0.625	(.266)	—	1	4,500	100.042	0.403	(.344)	—	1
65	1	2,600	100.207	1.489	.068	—	1	2,400	99.956	−0.303	.381	—	1
66	2	7,950	100.003	0.041	.484	—	1	7,050	99.930	−0.830	.203	—	1
68	1	4,650	99.955	−0.429	(.334)	—	—	5,350	100.005	0.048	(.481)	—	—
70	3	7,700	99.963	−0.459	(.323)	—	1	7,300	99.922	−0.940	.174	—	2

Table 1 (*continued*)

	PK+							PK					
Opr.	# Series	# Trials	Mean	z-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$	# Trials	Mean	z-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$
80	2	7,500	100.185	2.272	.012	1	1	7,500	99.871	−1.581	.057	1	2
82	2	4,100	100.193	1.745	.041	1	2	5,250	100.060	0.615	(.269)	—	—
84	1	2,500	100.102	0.724	.235	—	1	2,500	99.765	−1.663	.048	1	1
85	1	5,100	100.088	0.891	.186	—	1	5,300	100.180	1.851	(.032)	— (1)	1
88	1	2,750	100.169	1.254	.105	—	1	3,000	100.084	0.648	(.258)	—	—
90	1	2,500	100.088	0.619	.268	—	1	2,500	99.968	−0.229	.409	—	1
92	2	7,400	99.941	−0.722	(.235)	1 (1)	1	5,400	100.087	0.903	(.183)	— (1)	1
93	2	5,000	100.144	1.440	.075	—	2	5,000	100.019	0.194	(.423)	—	1
94	4	10,000	100.056	0.796	.213	1	2	10,000	99.939	−0.863	.194	—	3
96	1	2,250	100.073	0.492	.311	—	1	2,750	100.085	0.634	(.263)	—	—
97	1	2,500	100.110	0.781	.218	—	1	2,500	99.935	−0.461	.322	—	1
All	87	262,650	100.037	2.666	.004	10 (4)	53	259,800	99.966	−2.444	.007	8 (5)	56

	Baseline							ΔPK				
Opr.	# Series**	# Trials	Mean	z-Score	Prob.	# Series $p < .05$	# Series Mean > 100	# Trials	z-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$
10	13	59,100	100.011	0.389	.349	—	8	110,150	4.375	6×10^{-6}	4	14
14	3	7,250	99.936	−0.774	.219	—	1	15,800	1.756	.040	—	3
16	3	7,500	100.024	0.292	.385	—	1	15,000	2.658	.004	1	3
19	1	2,500	100.044	0.311	.378	—	1	5,750	−0.052	(.479)	—	—
20	3	7,500	99.956	−0.537	.296	—	0	15,000	0.940	.174	—	3
21	1	2,500	100.032	0.229	.409	—	1	5,000	−0.480	(.316)	—	—
29	1	2,500	100.076	0.540	.295	—	1	5,000	−0.670	(.251)	—	—
30	1	2,650	99.978	−0.162	.436	—	0	10,000	0.614	.270	—	1
33	1	2,500	100.053	0.376	.353	—	1	6,500	−0.607	(.272)	—	—
36	2	4,500	99.928	−0.679	.249	—	1	10,250	−0.650	(.258)	—	—

Table 1 (*continued*)

	Baseline							ΔPK				
Opr.	# Series**	# Trials	Mean	z-Score	Prob.	# Series $p < .05$	# Series Mean > 100	# Trials	z-Score	Prob.*	# Series $p < .05$*	# Series $p < .5$
41	3	9,800	100.012	0.166	.434	—	1	28,500	0.455	.325	—	4
42	1	2,500	99.964	−0.255	.400	—	0	5,000	0.364	.358	—	1
44	2	3,000	99.982	−0.137	.446	—	1	11,500	−0.860	(.195)	—	—
49	2	5,000	100.078	0.784	.217	—	2	10,000	−1.417	(.078)	— (1)	—
53	3	7,500	99.961	−0.477	.317	—	2	15,000	−0.386	(.350)	— (1)	2
55	10	40,000	100.004	0.113	.455	—	6	86,700	−0.194	(.423)	1 (1)	6
59	1	1,100	100.119	0.559	.288	—	1	9,000	0.798	.213	—	2
64	1	5,500	99.908	−0.965	.167	—	0	10,000	−0.734	(.232)	—	—
65	1	2,500	100.172	1.213	.112	—	1	5,000	1.284	.100	—	1
66	2	7,500	99.964	−0.444	.328	—	1	15,000	0.599	.275	—	1
68	1	4,950	100.158	1.572	.058	—	1	10,000	−0.328	(.371)	—	—
70	3	7,500	100.081	0.998	.159	—	2	15,000	0.327	.372	—	2
80	2	5,500	100.160	1.676	.047	—	2	15,000	2.724	.003	1	1
82	1	5,000	100.014	0.144	.443	—	1	9,350	0.695	.244	—	2
84	1	2,500	100.092	0.653	.257	—	1	5,000	1.688	.046	1	1
85	1	5,550	100.107	1.129	.129	—	1	10,400	−0.698	(.243)	—	—
88	1	2,900	99.915	−0.649	.258	—	0	5,750	0.399	.345	—	1
90	1	2,500	99.820	−1.270	.102	—	0	5,000	0.600	.274	—	1
92	2	4,950	99.900	−0.997	.159	—	0	12,800	−1.135	(.128)	1 (1)	1
93	2	5,000	99.827	−1.730	.042	—	0	10,000	0.881	.189	—	2
94	4	9,500	99.961	−0.543	.294	—	2	20,000	1.173	.120	1	3
96	1	2,500	99.914	−0.611	.271	—	0	5,000	−0.140	(.444)	—	—
97	1	2,500	100.104	0.735	.231	—	1	5,000	0.878	.190	—	1
All	76	243,750	100.004	0.282	.389	—	41	522,450	3.614	2×10^{-4}	10 (4)	56

* Numbers in parentheses indicate results opposite to intention.

** In some early series baselines were generated by experimenters, and these are not included in the table.

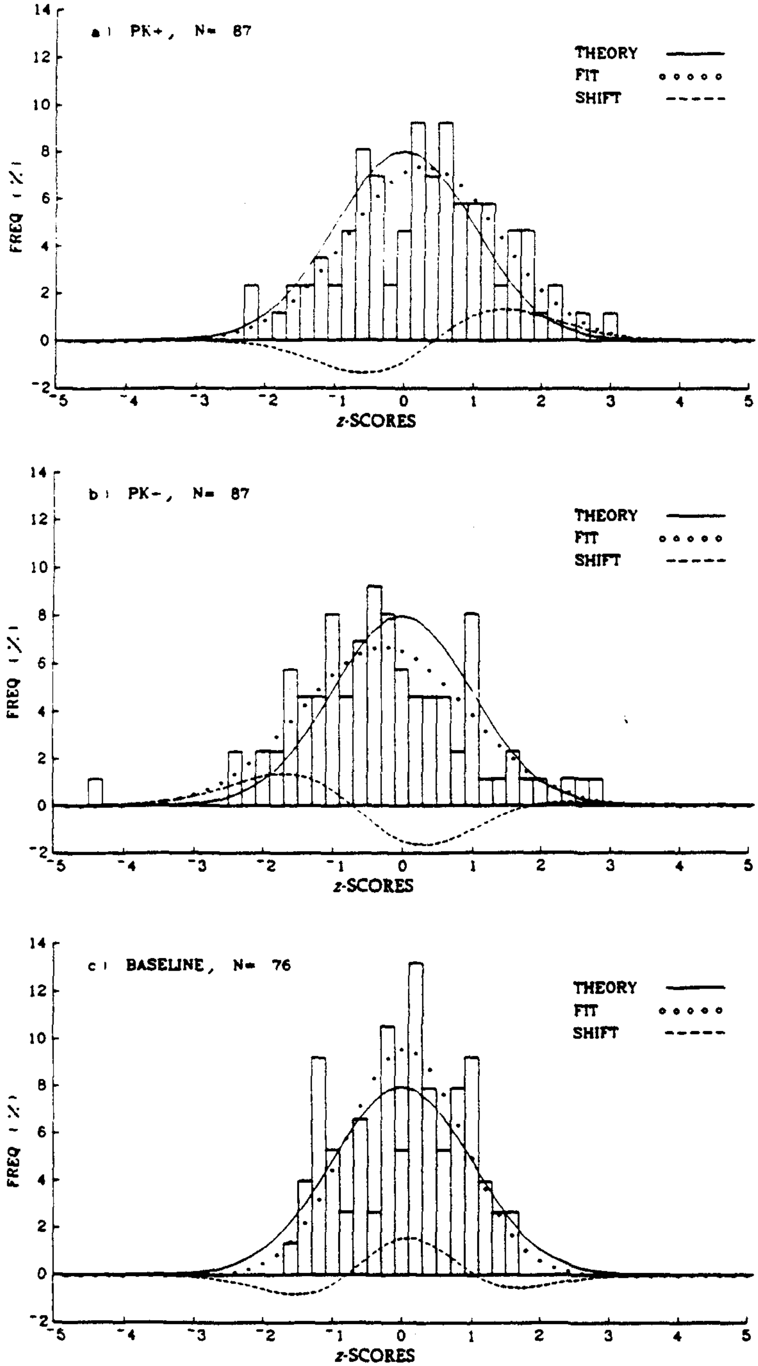


Fig. 7. REG frequency of series z-scores: All data, 33 operators.

units have indeed been so employed, with no discernible consequences on the overall pattern of data.

In an attempt to explore this issue more aggressively, a categorically different random source has been developed that may properly be termed "pseudo-random" in character. This device employs a feedback array of 31 microelectronic shift registers that produces a determinate repeating sequence of 2×10^9 bits at a set clock frequency. In the mode most commonly employed, this determinate sequence cycles continuously with a repetition period of about 60 hours, so that the only remaining non-deterministic aspect of the experiment is the time of incursion initiated by the operator. This pseudo-random source can be switched into the standard REG apparatus at an appropriate location, replacing the commercial microelectronic noise diode and its conditioning circuitry but leaving all subsequent sampling, counting, and display circuitry, feedback, and software identical to the standard version. From the perspective of the operator, this system is virtually indistinguishable from that of the standard REG, save for an identifying code printed on the strip tape, and the experimental protocols employed are identical. The results of 29 experimental series employing this pseudo-random source are also statistically significant with a probability against chance of .003, (Fig. 8 and Table 2), and the individual operator signatures show strong qualitative similarities to those achieved on the standard REG.

To pursue further the question of how device-specific are such signatures of achievement, a substantially different experimental device called a "Random Mechanical Cascade" (RMC) has been employed (Nelson, Dunne, & Jahn, 1987). This apparatus, some 6′ × 10′ in dimension, allows 9,000 ¾″ polystyrene spheres to trickle downward through a quincunx array of 330 ¾″ diameter nylon pegs, whereby they are scattered into 19 collecting bins across the bot-

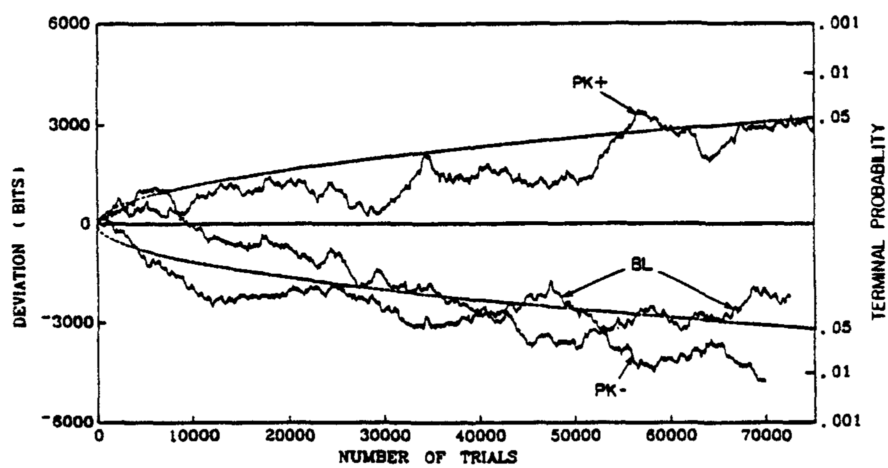


Fig. 8. Pseudo-REG cummulative deviations from theoretical mean: All data, 10 operators.

TABLE 2
Pseudo-REG data summary by operator

	PK⁺							PK⁻					
Opr.	# Series	# Trials	Mean	z-Score	Prob.	# Series $p < .05$	# Series $p < .5$	# Trials	Mean	z-Score	Prob.	# Series $p < .05$	# Series $p < .5$
10	9	23,000	100.059	1.269	.102	2	4	22,000	99.845	−3.249	.001	2	8
14	1	2,300	100.339	2.300	.011	1	1	2,700	100.197	1.448	(.074)	—	—
15	1	2,500	99.788	−1.499	(.067)	—	—	2,500	99.802	−1.397	.081	—	1
16	1	2,500	100.385	2.724	.003	1	1	2,500	100.122	0.860	(.195)	—	—
41	2	5,600	99.928	−0.758	(.224)	—	—	4,400	99.934	−0.616	.269	—	1
55	9	23,400	99.988	−0.251	(.401)	—	3	21,600	99.986	−0.293	.385	1	4
70	2	5,450	99.933	−0.695	(.243)	— (1)	1	4,550	99.921	−0.751	.226	1	1
80	1	2,500	100.082	0.583	.280	—	1	2,500	99.984	−0.116	.454	—	1
88	1	2,500	99.953	−0.334	(.369)	—	—	2,500	99.748	−1.782	.037	1	1
94	2	5,400	100.208	2.161	.015	1	2	4,600	99.978	−0.215	.415	—	1
All	29	75,150	100.037	1.418	.078	5 (1)	13	69,850	99.931	−2.564	.005	5	18

	Baseline							ΔPK				
Opr.	# Series	# Trials	Mean	z-Score	Prob.	Series $p < .05$	# Series Mean > 100	# Trials	z-Score	Prob.	# Series $p < .05$	# Series $p < .5$
10	9	22,500	99.957	−0.904	.183	—	3	45,000	3.179	.001	3	7
14	1	2,500	100.019	0.133	.447	—	1	5,000	0.496	.310	—	1
15	1	2,500	100.183	1.293	.098	—	1	5,000	−0.072	(.471)	—	—
16	1	2,500	99.875	−0.882	.189	—	0	5,000	1.318	.094	—	1
41	2	5,000	100.138	1.384	.083	—	2	10,000	−0.158	(.437)	—	1
55	9	22,500	99.939	−1.291	.098	—	2	45,000	0.022	.491	1 (1)	5
70	2	5,000	100.139	1.392	.082	—	2	10,000	−0.007	(.497)	1 (1)	1
80	1	2,500	100.089	0.631	.264	—	1	5,000	0.494	.311	—	1
88	1	2,500	99.886	−0.809	.209	—	0	5,000	1.024	.153	—	1
94	2	5,000	99.717	−2.834	.002	1	0	10,000	1.734	.041	1	2
All	29	72,500	99.969	−1.170	.121	1	12	145,000	2.801	.003	6 (2)	20

tom, filling them in close approximation to a Gaussian distribution (Fig. 9). The growing population of each of the bins is tracked photoelectrically and displayed via LED counters at the bottom of that bin, and recorded on-line in an appropriately coded computer file. The experimental protocol calls for the operator, seated on a couch approximately eight feet from the machine, to attempt on volition or instruction to distort the distribution to the right

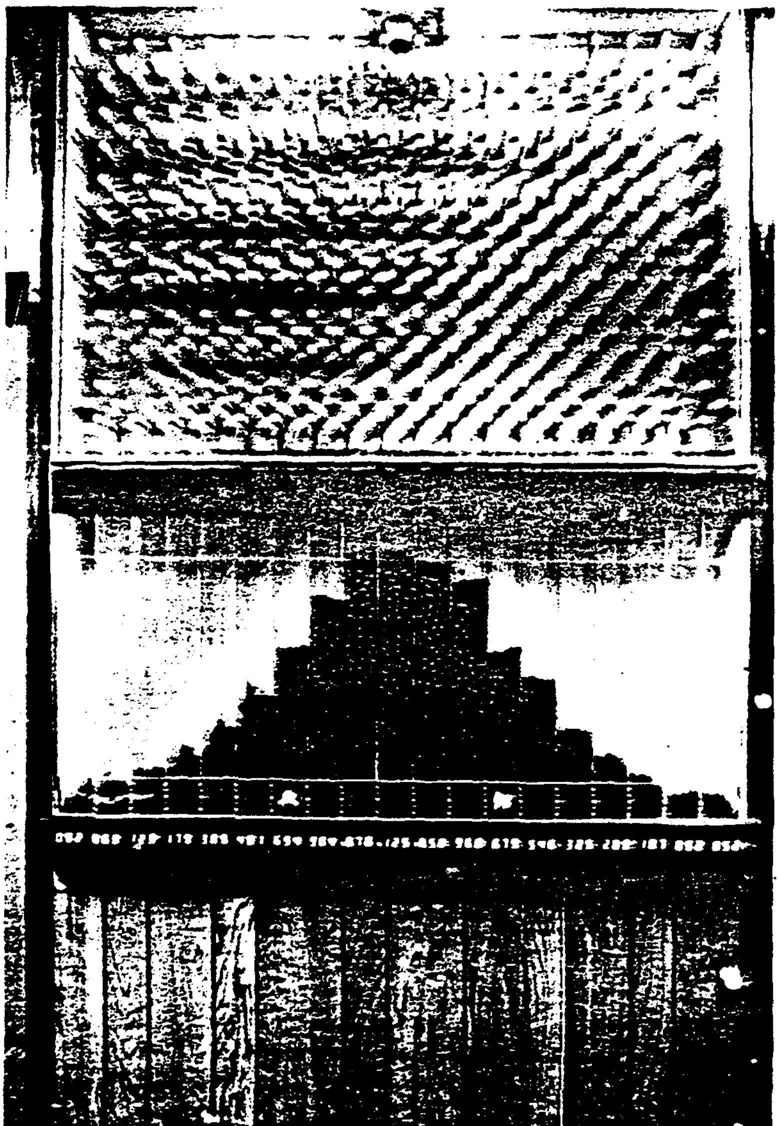


Fig. 9. Random mechanical cascade.

(PK^+) or to the left (PK^-), or to generate baselines. All data are acquired in concomitant sets of three runs, one under each of these intentions, to control against unforeseen artifactual influences. The temperature and humidity within the RMC apparatus are routinely recorded to assess any possible correlations with the experimental data.

Figure 10(a) displays as cumulative deviations the data of all 3072 runs by the 22 operators who have completed at least one formal series of 10 or 20 runs per intention. Once again, the total aberration is statistically significant, to the order of 3×10^{-6}, but in this case only the left-going efforts are independently significant. As can be seen in Table 3, most of this asymmetry is due to the characteristic contributions of two operators who happen to have exceptionally large individual data bases. With these two omitted, the com-

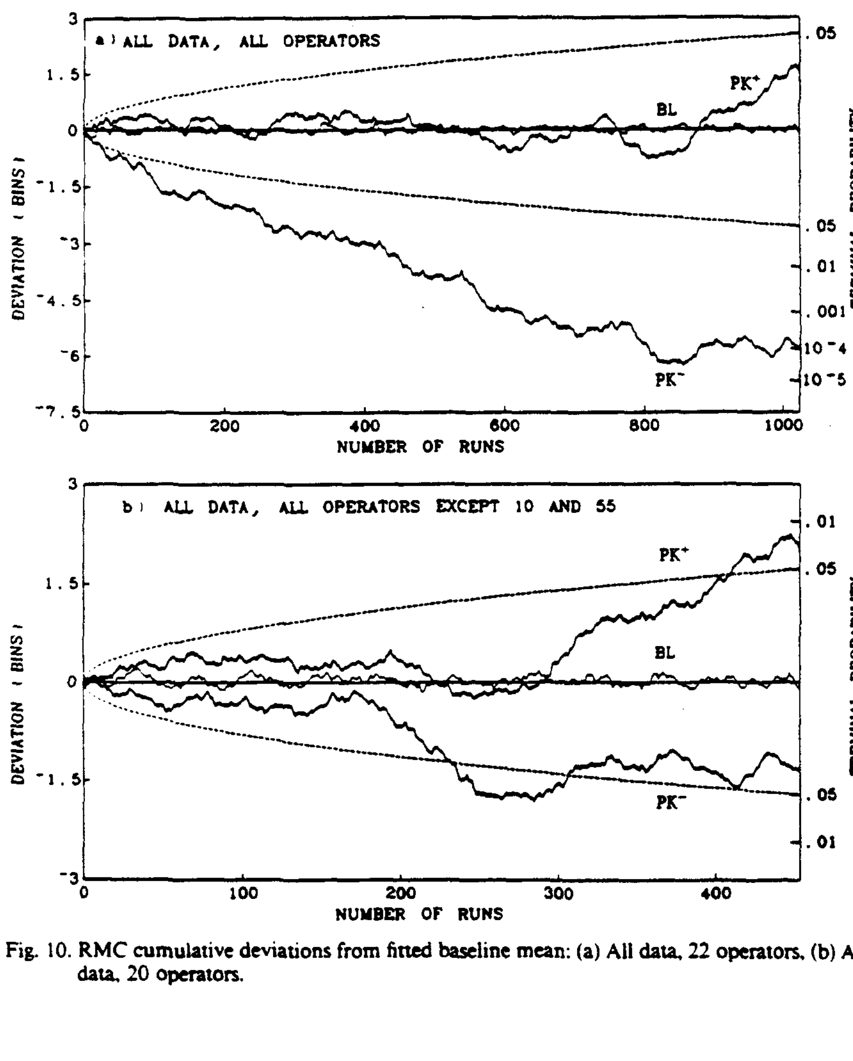


Fig. 10. RMC cumulative deviations from fitted baseline mean: (a) All data, 22 operators, (b) All data, 20 operators.

TABLE 3
RMC data summary by operator

Opr.	# Series	# Runs	BL mean	Mean	*SD**	*t*-Score*	Prob.	# Series $p < .05$	# Series $p < .5$
				PK⁺ (right)					
10	17	270	10.0328	10.0297	.0508	−0.987	(.162)	— (2)	6
14	1	20	10.0336	10.0284	.0497	−.0472	(.321)	—	—
16	3	30	10.0111	10.0246	.0496	1.497	.073	—	3
20	2	20	10.0002	10.0226	.0505	1.975	.031	1	2
41	7	90	10.0205	10.0240	.0533	0.620	.268	—	4
42	3	30	9.9913	10.0181	.0452	3.248	.001	1	3
44	1	20	10.0419	10.0361	.0457	−0.571	(.287)	—	—
49	1	10	10.0219	10.0291	.0462	0.488	.319	—	1
51	1	10	10.0047	10.0066	.0456	0.133	.448	—	1
53	1	10	10.0283	10.0214	.0682	−0.321	(.378)	—	—
55	20	300	10.0272	10.0283	.0497	0.374	.354	2 (1)	11
63	1	7	10.0207	10.0342	.0458	0.782	.232	—	1
64	1	10	10.0164	10.0219	.0476	0.364	.362	—	1
66	1	10	10.0210	9.9907	.0306	−3.142	(.006)	— (1)	—
68	2	40	10.0224	10.0180	.0453	−0.608	(.273)	—	1
69	1	11	10.0463	10.0253	.0679	−1.023	(.165)	—	—
70	4	40	10.0166	10.0278	.0541	1.310	.099	—	4
79	1	9	10.0214	10.0448	.0649	1.079	.156	—	1
84	1	10	10.0237	10.0348	.0376	0.937	.187	—	1
91	1	16	10.0290	10.0325	.0462	0.306	.382	—	1
93	3	31	10.0142	10.0219	.0492	0.875	.194	—	2
94	3	30	10.0041	9.9977	.0557	−0.636	(.265)	— (1)	2
All	76	1024	10.0245	10.0260	.0506	0.978	.164	4 (5)	45
				PK⁻ (left)					
10	17	270	10.0328	10.0195	.0536	−4.076	3×10^{-5}	6	14
14	1	20	10.0336	10.0259	.0418	−0.822	.211	—	1
16	3	30	10.0111	9.9994	.0507	−1.256	.110	1	2
20	2	20	10.0002	10.0259	.0448	2.566	(.009)	— (1)	—
41	7	90	10.0205	10.0241	.0488	0.697	(.244)	—	3
42	3	30	9.9913	9.9990	.0502	0.838	(.204)	—	—
44	1	20	10.0419	10.0342	.0484	−0.713	.242	—	1
49	1	10	10.0219	10.0212	.0369	−0.058	.478	—	1
51	1	10	10.0047	10.0002	.0322	−0.436	.337	—	1
53	1	10	10.0283	10.0195	.0632	−0.444	.334	—	1
55	20	300	10.0272	10.0244	.0494	−0.985	.163	1	13
63	1	7	10.0207	10.0126	.0391	−0.550	.301	—	1
64	1	10	10.0164	10.0241	.0506	0.482	(.321)	—	—
66	1	10	10.0210	10.0017	.0590	−1.038	.163	—	1
68	2	40	10.0224	10.0221	.0469	−0.031	.488	1 (1)	1
69	1	11	10.0463	10.0121	.0680	−1.664	.064	—	1
70	4	40	10.0166	10.0122	.0454	−0.627	.267	—	2
79	1	9	10.0214	10.0329	.0394	0.872	(.204)	—	—
84	1	10	10.0237	10.0175	.0516	−0.375	.358	—	1
91	1	16	10.0290	10.0395	.0566	0.743	(.235)	—	—
93	3	31	10.0142	10.0045	.0440	−1.221	.116	—	2
94	3	30	10.0041	9.9841	.0467	−2.350	.013	1	3
All	76	1024	10.0245	10.0190	.0503	−3.473	3×10^{-4}	10 (2)	49

Table 3 (*continued*)

Opr.	# Series	# Runs	BL mean	# Pairs of runs	*SD**	*t*-Score*	Prob.	# Series $p < .05$	# Series $p < .5$
				ΔPK (right–left)**					
10	17	270	10.0328	270	.0521	3.235	7×10^{-4}	7 (1)	11
14	1	20	10.0336	20	.0402	0.270	.395	—	1
16	3	30	10.0111	30	.0515	2.683	.006	1	3
20	2	20	10.0002	20	.0328	−0.461	(.325)	— (1)	1
41	7	90	10.0205	90	.0530	−0.018	(.493)	— (1)	3
42	3	30	9.9913	30	.0432	2.427	.011	1	3
44	1	20	10.0419	20	.0531	0.158	.438	—	1
49	1	10	10.0219	10	.0375	0.659	.263	—	1
51	1	10	10.0047	10	.0307	0.655	.264	—	1
53	1	10	10.0283	10	.0288	0.214	.418	—	1
55	20	300	10.0272	300	.0490	1.373	.085	2	13
63	1	7	10.0207	7	.0358	1.600	.080	—	1
64	1	10	10.0164	10	.0523	−0.134	(.448)	—	—
66	1	10	10.0210	10	.0478	−0.728	(.243)	—	—
68	2	40	10.0224	40	.0511	−0.510	(.306)	—	1
69	1	11	10.0463	11	.0359	1.218	.126	—	1
70	4	40	10.0166	40	.0463	2.143	.019	2	3
79	1	9	10.0214	9	.0666	0.535	.303	—	1
84	1	10	10.0237	10	.0566	0.965	.180	—	1
91	1	16	10.0290	16	.0383	−0.729	(.239)	—	—
93	3	31	10.0142	31	.0466	2.075	.023	—	3
94	3	30	10.0041	30	.0462	1.606	.060	—	3
All	76	1024	10.0245	1024	.0489	4.581	3×10^{-6}	13 (3)	53

* The *t*-score calculation for paired data replaces the usual *z*-score in these experiments, since an empirical baseline distribution is used as a reference in lieu of a theoretical distribution. For this calculation an empirical standard deviation (*SD*) of the differences of the means is also required.

** The ΔPK *t*-score is calculated for the difference between the PK^+ and PK^- data, unlike the REG data where ΔPK reflects the combined effect in direction of intention.

bined results of the remaining 20 operators are more symmetrical and still significant to the order of 7×10^{-4} [Fig. 10(b)].

Perhaps more importantly, the RMC results indicate operator-specific patterns of achievement similar to those found in the REG and pseudo-REG experiments, despite the widely different physical processes these three devices embody, a feature that may bear substantial implications for basic comprehension of the phenomena involved. For example, Fig. 11 compares the PK^+ and PK^- signatures of the same operator on all three PK experiments: the microelectonic REG, the deterministic pseudo-REG, and the macroscopic mechanical RMC. Each of these graphs represents a concatenation of a substantial number of experimental series conducted over long periods of time. Similar correspondences have been observed for a number of other operators, despite their characteristically different individual signatures. Thus it appears that although the observed effects are clearly operator-specific, and in many

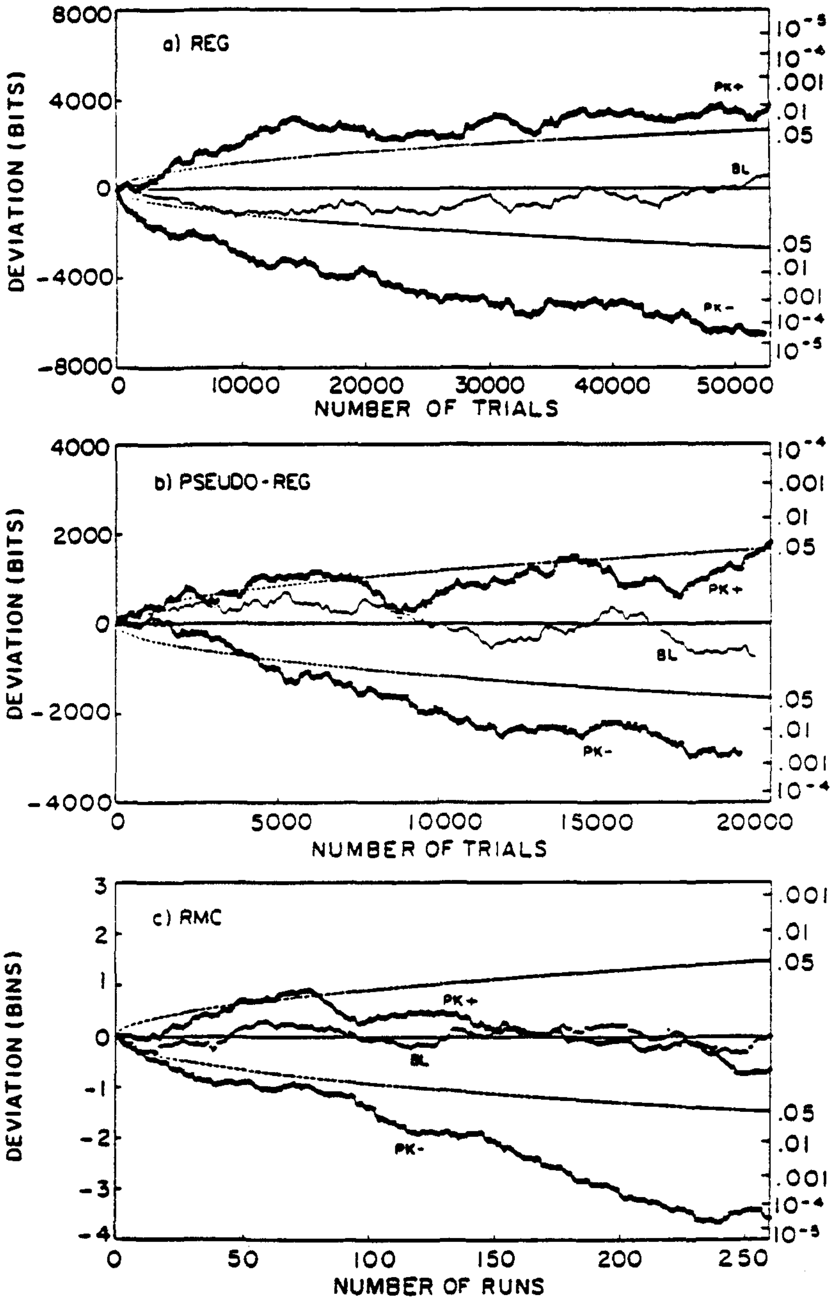


Fig. 11. Cumulative deviations: 3 devices, (operator 10).

cases condition-specific, they seem not to be nearly so device-specific. Such empirical evidence weakens phenomenological interpretations involving consciousness interacting directly with the random physical process itself, for example, with the flux of thermal electrons in the REG, or of the polystyrene balls in the RMC, and favors models that deal with aspects generic to all of these systems, for example, the information implicit in their output distributions.

Precognitive Remote Perception

The second major class of experimentation concerns the anomalous acquisition of information about remote geographical targets, inaccessible by any known sensory channel. The particular protocol followed is a variation on numerous similar studies elsewhere (Dunne & Bisaha, 1979; Hansen, Schlitz, & Tart, 1983; Puthoff & Targ, 1976; Schlitz & Gruber, 1980; Tart, Puthoff, & Targ, 1979), and is termed precognitive remote perception (PRP). Essentially, one participant, called the "percipient," is asked to generate a description of an unknown location where a second participant, called the "agent" is, was, or will be situated at a prescribed time. Initially the percipient records his impressions about the target in a free-response, stream-of-consciousness style, and then encodes them in some structured form amenable to analytical processing.

Most of the experiments reported here were conducted in a precognitive mode, wherein the percipient's impressions are recorded before the agent visits the target and, in many cases, before the target is even selected. Two modes of target selection have been employed, with no discernible effect on the experimental results. In the "instructed" mode, the target for each experiment is randomly selected from a large pool of potential targets previously prepared by a third person not otherwise involved in the experiment or its evaluation, and maintained so that no percipient or agent has access to it. In the "volitional" mode, the target is arbitrarily selected by the agent at the time specified for its visitation.

Figures 12–14 show a few examples of typical targets with portions of the corresponding free-response descriptions; more extensive data are presented elsewhere (Dunne, Jahn, & Nelson, 1983; Dunne, Jahn, & Nelson, 1985; Jahn, 1982; Jahn & Dunne, 1986, 1987; Nelson, Jahn, & Dunne, 1986). At present, the data in hand consist of 334 perceptions of this sort that range from virtually photographic accuracy, through varying degrees of correspondence to the details and overall ambience of the scene, to total irrelevance. In some cases, details that are central to the agent's view of the scene are ignored by the percipient, while minor aspects are escalated in importance. In other cases, there are spatial inversions or other geometrical distortions. Frequently, the more impressionistic aspects seem to be perceived more accurately than the analytical details.

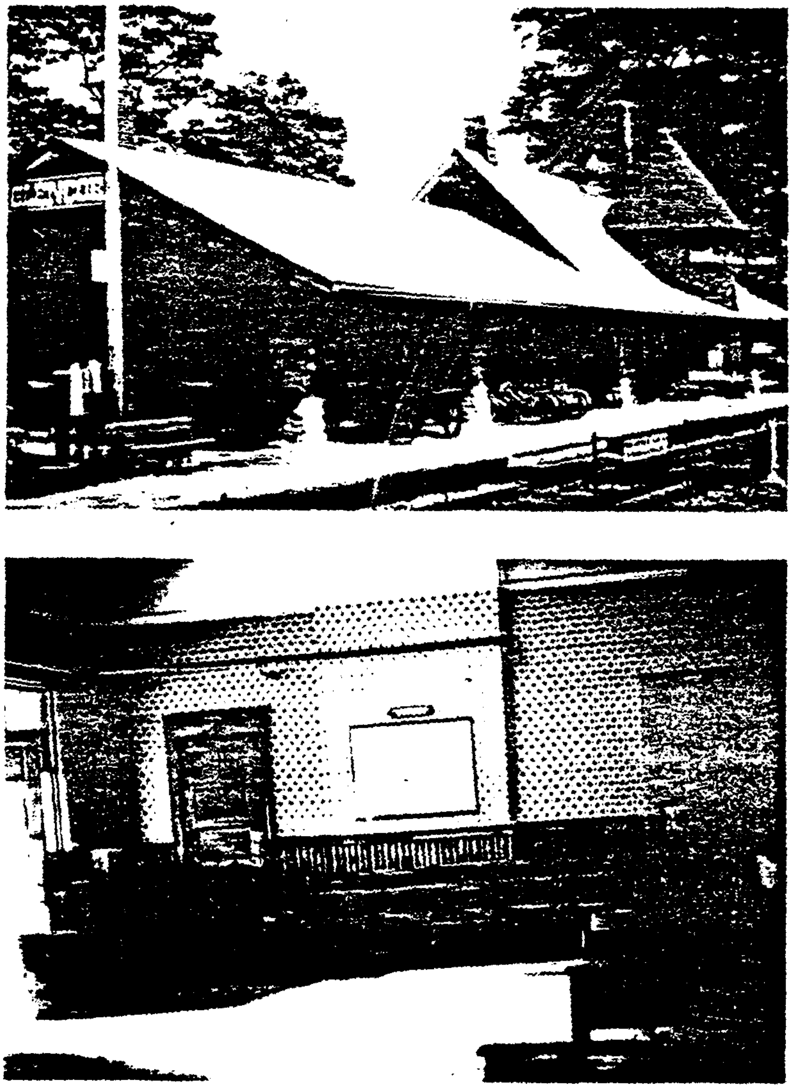


Fig. 12. PRP Target: NWRR station, Glencoe, Illinois. The percipient was some five or six miles away. The perception, generated 35 minutes precognitively, reads, in part:

". . . I see a train station, one of the commuter train stations that's on the expressway . . . I see a train coming . . . See just the front end of the train station. See a little bit within it. I think there are wooden planks on the floor. I hear like the clicking . . . of feet or shoes on the wooden floor . . . There are posters or something up, some kind of advertisements or posters on the wall in the train station. I see the benches. Getting the image of a sign, but I think it's probably the sign of what station it is. It's about 8 or 10 letters in the word. Maybe something like Clydeburn or Clayburn. Have the impression of this wooden floor being somewhat littered, just sort of dirty. I see the tracks. No train on the tracks right now. Empty tracks. . . ."

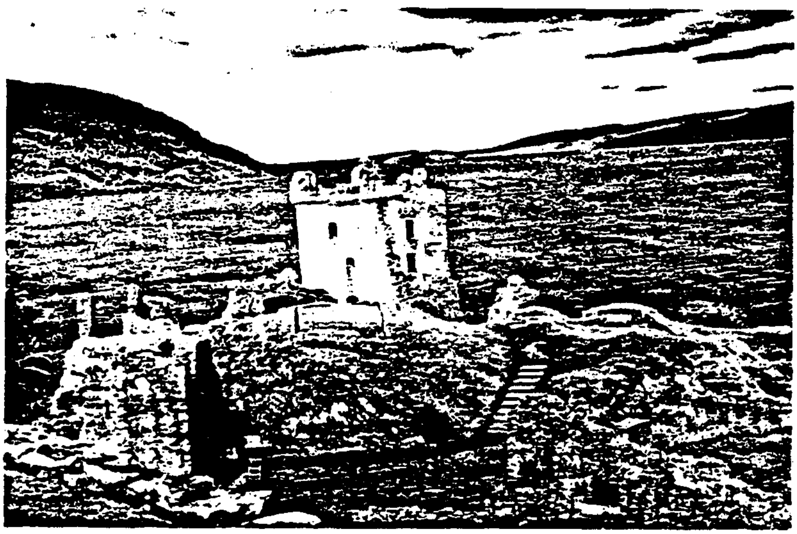


Fig. 13. PRP Target: Ruins of Urquardt Castle, Loch Ness, Scotland. The percipient was in New York City, some 3500 miles away. The perception, generated 14 hours retrocognitively, reads:

"Rocks with uneven holes. Also smoothness. Height. Ocean. Dark. Dark blue. White caps. Waves booming against rocks? On mountain or high rocks overlooking water. Dark green in distance. Gulls flying? Pelican on a post. Sand. A lighthouse? Tall structure. Round with a conical roof. High windows or window space with a path leading up to it. Or a larger structure or a castle." (Here there is a sketch of a castle abutment on the transcript.) "Old. Unused. Fallen apart. Feeling musty, or dark. Moss or grass growing in walls. Wood draw bridge? A black dog? Snow. Ice capping a mountain. High large cavernous hall. Castle."

The principal effort in this study has been to devise analytical methods to extract from such subjective evidence some quantitative measure of the degree of anomalous information acquisition. For this purpose, a code, or alphabet, of simple descriptive queries is employed, which can be addressed to all targets and all perceptions. These descriptors, 30 in number, range over a spectrum from quite factual discriminations, for example, whether the scene is indoors or outdoors, whether trees are present, or whether there are automobiles, to much more subjective aspects, such as whether the ambience is noisy or quiet, confined or expansive, hectic, or tranquil. Encoding of the target is normally performed by the agent at the time of visitation, and of the perception by the percipient after the free-response impression of the target has been recorded.

With the target and perception thus encoded, a variety of analytical scoring methods are invoked, described in detail elsewhere (Dunne et al., 1983; Jahn, Dunne, & Jahn, 1980; Jahn et al., 1982), that yield numerical scores indicative of the information content of each perception relative to its corresponding target. Most of these methods acknowledge the a priori probabilities of the various descriptors, that is, that more scenes tend to be outdoors than indoors, that more tend to have people in them than not, etc.; therefore, a perception

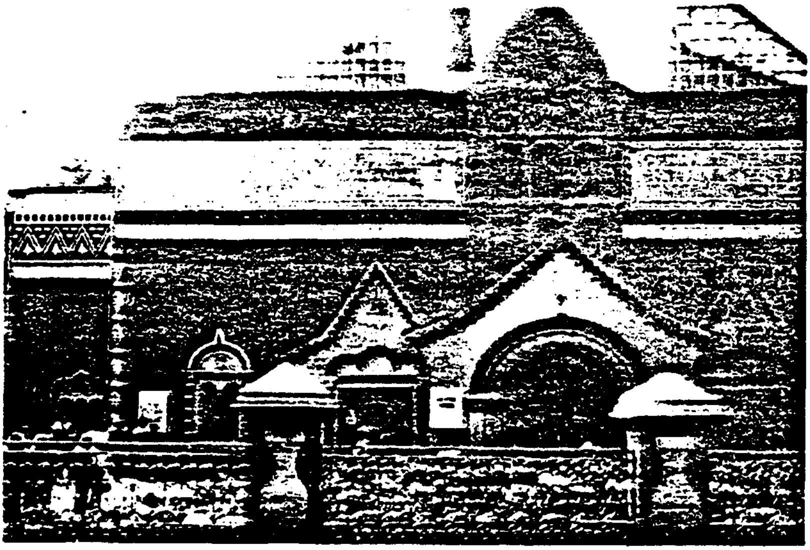


Fig. 14. PRP Target: Tretiakovskaia Gallereia, Moscow, U.S.S.R. The percipient was in Wisconsin, some 4500 miles away. The perception, generated 24 hours precognitively, reads, in part: "Have the sensation of being in a very quiet, sombre, subdued sort of atmosphere. . . . Any color impressions I get are the same—greys, browns, dark subdued colors. I feel an oldness. . . . I'm thinking of a large church or something, or a castle. Some kind of building. It seems to be quite large. Sensation of sounds echoing, subdued colors. . . . I see several, maybe two to four round balls that seem to be on top of something. Maybe it's some kind of decoration. Like on top of something that's of a generally square shape. Almost like a square column with a ball on top. I have a very clear picture suddenly of an old building. It's quite large. There are windows with, like, arches. They may not be exactly arched; the arches come to a point on top, almost. Very impressive. It's a light grey color, very ornate. It comes to a point of some sort, but it's not a regular point. Like where it should be round on top it comes to a point. I'm not sure if it's windows or the shape of the building itself. . . . Great big double doors. . . . Just saw those square pillars with the balls on top again. They seem to be almost like an entranceway, one on either side. . . ."

that is accurate about less likely aspects achieves a higher score than one that correctly predicts more likely features. The scores are all normalized in some fashion, for example, by various chance expectations or by perfect scores. In some recipes ternary or quaternary descriptor responses are also employed, whereby the agent and the percipient can effectively reject or equivocate on a question, or express gradations of its importance.

The most powerful aspect of this coding approach is that unlike traditional impressionistic ranking procedures, digital scoring algorithms can be applied to compare any perception with a very large number of alternative targets—not just the 5 or 10 that could be compared by a human judge. The distribution of the mismatch scores, that is, the off-diagonal matrix elements of the perception/target array, has sufficiently Gaussian characteristics to serve as an empirical "chance" reference for statistical quantification of the correctly matched scores. The process is illustrated in Fig. 15, where the larger dashed curve is the empirical chance distribution thus constructed by one particular binary scoring method from some 42,000 mismatch scores. In comparison, the solid line, denoting the distribution of proper target scores for 334 formal trials is seen to be distorted to the high score side. If we remove from that proper target score distribution the largest component that is a subset of the empirical chance distribution, (dotted curve), the residue (dot-dashed curve) should be an indication of the information acquired beyond the chance expectation for guessing. In this case, about 15% of the trial scores are involved in that extra-chance, positive information residue. More detailed numerical calculation yields a probability for this degree of information acquisition by chance of about 10^{-11} for the data and method illustrated. The other scoring methods show comparable results (Dunne, Jahn, & Nelson, 1983).

A primary interest is the dependence of this extra-chance information component on the physical parameters of the experiment, most notably on the distance between the percipient and the agent. As illustrated in Fig. 16, within the accuracy of the data and the statistical treatment just described, no significant dependence is found; up to intercontinental distances of several thousand miles, there appears to be no discernible advantage for closer targets. Certainly, there is no $1/r^2$ dependence that might be expected for various wave-propagation mechanisms that have been proposed for such phenomena (Kogan, 1968; Chari, 1977; Persinger, 1979).

Perhaps even more striking is the absence of any discernible dependence of perception accuracy on the time interval between perception effort and target visitation by the agent. Figure 17 shows the 334 formal trial scores

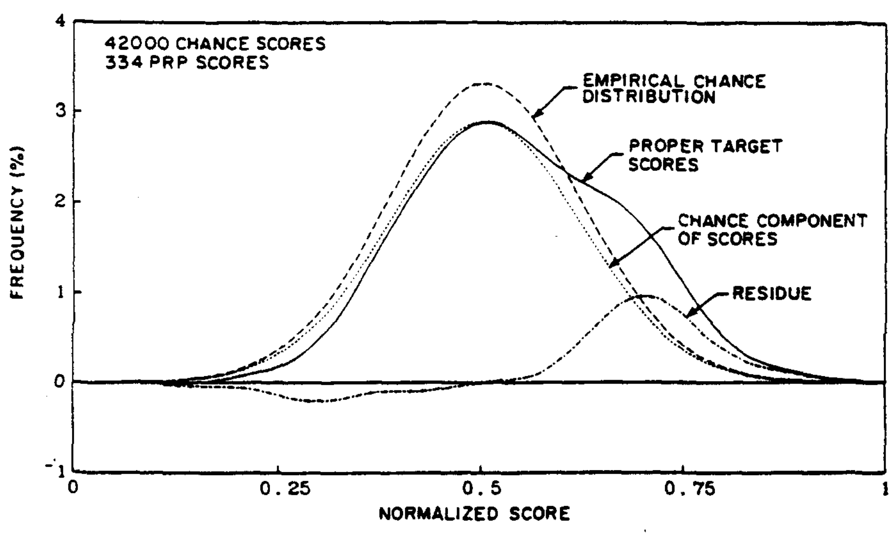


Fig. 15. PRP score distribution.

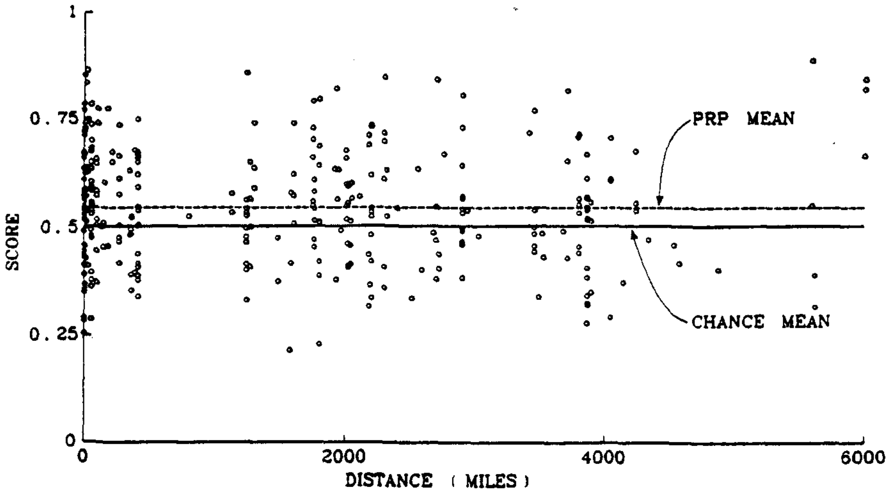


Fig. 16. PRP scores versus spatial separation, $N = 334$.

arrayed as a function of this time displacement. Zero abscissa denotes that the perception was dictated at the time of target visitation. Times to the right of this correspond to perceptions that were attempted precognitively by the indicated number of hours. Times to the left comprise a smaller body of data taken retrocognitively, wherein the percipient dictated the perception after the target had been visited, but before any information had been transferred by ordinary means. Again, over the range covered by these experiments, there

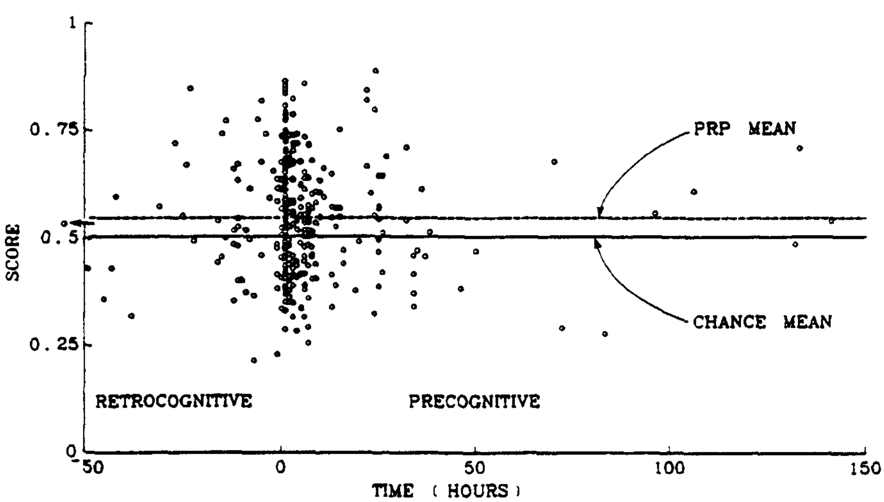


Fig. 17. PRP scores versus temporal separation, $N = 334$.

is no statistically significant dependence on this temporal parameter. Identification of the specific process whereby the consciousness of a percipient is apparently able to access points remote in both space and time from its current physical location is well beyond our present understanding, but data such as displayed in Figs. 16 and 17, if sustained in further experimentation, will severely delimit the physical mechanisms that could legitimately be invoked.

Clearly there is also interest in the dependence of the yield of such experiments on the psychological characteristics and strategies of the percipients and agents, both separately and as paired participants, but as noted earlier, this category of correlation has not been extensively pursued, in part because the data base is still far too small for such analyses to be effective. Nonetheless, the compounding data are routinely examined to gather impressions about the efficacy of the descriptor questions, the variability in individual interpretation of and response to the descriptors, and the physical and psychological correlates of the most successful trials.

Theoretical Considerations

Experiments like those outlined above beg for some form of theoretical model to help correlate data, design more incisive experiments, and interpret the observed effects in more fundamental terms. The literature of psychic research abounds with attempts to transpose various physical formalisms to this purpose: electromagnetic models, thermodynamic models, mechanical models, statistical mechanical models, hyperspace models, quantum mechanical models, and others (Bohm, 1971; Chari, 1977; Costa de Beauregard, 1979; Feinberg, 1975; Kogan, 1968; Persinger, 1979; Rauscher, 1979; von Lucadou & Kornwachs, 1979). Although these comprise an interesting body of effort, none of them seems fully competent to accommodate experimental data like those described above. Indeed, it appears that no simple application of existing physical theory is likely to prevail. In order to encompass the observed effects, a substantially more fundamental level of theoretical model will need be deployed, one which more explicitly acknowledges the role of consciousness in the definition of physical reality.

The model that has so far proven most serviceable for our purposes takes the position that reality, or experience, is constituted only in the interaction of consciousness with its environment, and thus that any physical theory, or any other scheme of conceptual organization, can only properly address the interaction, not the environment or the consciousness, per se. Similarly, it regards the common concepts and formalisms of physical theories as no more than useful organizing strategies adopted by the consciousness to order and process the information it acquires from the environment. Therefore, these should be as much reflective of the characteristics of the consciousness as of those of the environment or, more precisely, they should reflect the characteristics of the interaction of the two.

In this spirit, the model attempts to apply, via metaphor, the concepts and formalisms of elementary quantum mechanics to a representation of the interaction of consciousness with physical systems and processes, in a form that can accommodate both "normal" and "anomalous" behavior. Central to this metaphor is the assignment to consciousness of a partially wave-like character which can manifest itself in various interactions, much like the wave/particle duality of atomic scale phenomena. More specifically, by representing consciousness by quantum mechanical wave functions, and its physical environment by appropriate potential energy profiles, Schrödinger wave mechanics may be used to derive eigenfunctions and eigenvalues that can be associated with both the psychological and physical experiences of the consciousness/environment interaction. To bring this metaphor to pragmatic utility, it is necessary to relate certain mathematical aspects of the formalism, such as the coordinate system, the quantum numbers, and even the metric itself, with various impressionistic descriptors of consciousness, such as its intensity, perspective, approach/avoidance attitude, balance between cognitive and emotional activity, and receptive/active disposition. With these in hand, the generic principles of quantum mechanics—uncertainty, indistinguishability, correspondence, exclusion, etc.—as well as a number of specific computational applications, such as the central force field and atomic structure, covalent molecular bonds, barrier penetration, and quantum statistical collective behavior, become useful analogies for representation and correlation of a variety of consciousness-related physical effects, both normal and anomalous, and for the design of experiments to study these more systematically.

The full text and mechanics of this model are developed elsewhere (Jahn & Dunne, 1986, 1987), along with its application to particular experimental situations. Even in its comprehensive form, since the various associations it invokes are largely intuitive and empirical, and since few quantitative scales of consciousness properties yet exist, no more than semi-quantitative correlations can so far be made. Notwithstanding, comparison of our laboratory data and the informal testimony of our operators with appropriate aspects of the model have substantiated our confidence in the potential utility of the quantum mechanical metaphor and confirmed its value in providing a viable perspective and a facile language for the design of better experiments and the informal representation of the operators' cognitive and emotional attitudes and strategies. Beyond this, the model suggests a number of testable hypotheses, some of which are currently under study. For example, the postulated wave-mechanical nature of consciousness/environment interactions implies that the combined efforts of two or more consciousnesses attending to the same task may display constructive or destructive interference patterns, rather than simple linear superpositions. To test this, experiments utilizing the REG and RMC devices are underway to explore the effects of multiple operators addressing the same task simultaneously, compared to their individual signatures of achievement, and preliminary results appear to support the model. Yet other experiments are investigating the effects of spatial separation between operator and device, to be compared with the same operator's performance under proximate conditions, in an effort to comprehend the consciousness distance parameter.

Applications and Implications

As mentioned in the introduction, this program of research is intended to address aspects of anomalous consciousness-related phenomena that could bear on engineering practice, in both the short and longer terms. Based on the results obtained to date, a few domains of immediate relevance indeed appear to merit more specific and detailed study, and others may present themselves in the longer view. In particular, the results with the random event generators raise the generic possibility of anomalous effects arising from conscious or unconscious interactions between human operators and any sensitive microelectronic information processing devices or systems, most especially those involving random or pseudo-random noise elements for signal initiation or reference profiles. In the remote perception category, numerous current applications of such techniques in national security and law enforcement, archaeological searches, natural resource prospecting and medical diagnosis, employing various aspects of the experimental and analytical techniques outlined above, could be cited. As in the basic research, the emphasis in many of these applications has already shifted from credibility demonstration to refinement of protocols, participant strategies, and data analysis techniques to enhance their individual and collective efficacy.

It is premature to speculate on the broader and more fundamental implications of the empirical results and supporting model to the basic scientific paradigm, other than possibly to suggest that some generalization of the prevailing "particulate" view of consciousness, with its linear, causal, objective premises, to a more "wave-mechanical," participatory, holistic conceptualization may allow the observed "anomalous" phenomena to be accommodated as normal consequences of bonded-system behavior.

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