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The PEAR Proposition

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Abstract—For more than a quarter century, the Princeton Engineering Anomalies Research (PEAR) laboratory has engaged in a broad range of experiments on consciousness-related physical anomalies and has proposed a corresponding selection of theoretical models that have combined to illuminate the fundamental nature of the provocative phenomena that emerge. Productive pursuit of this topic has inescapably involved a spectrum of political, cultural, personal, and interpersonal factors that are normally not encountered in more conventional scientific scholarship, but have both enriched and complicated the enterprise in many ways. Some of the insights gleaned from the work are objectively specifiable, such as the scale and structural character of the anomalous effects; their relative insensitivity to objective physical correlates, including distance and time; the oscillating sequential patterns of performance they display; the major discrepancies between male and female achievements; and their irregular replicability at all levels of experience. But many others relate to subjective issues, such as the responsiveness of the effects to conscious and unconscious intention and to individual and collective resonance; the relevance of ambience and attitude in their generation; and the importance of intrinsic uncertainty as a source of the anomalies. This blend of empirical features predicates radical excursions of the dedicated models, and hence of the more general scientific paradigms, to allow consciousness and its subjective information processing capacities a proactive role in the establishment of objective reality, with all of the complications of specificity, causality, and reproducibility that entails. The attendant complexities of conceptualization, formulation, and implementation notwithstanding, pragmatic applications of these phenomena in many sectors of public endeavor now can be foreseen.

Keywords: complementarity—consciousness—human/machine anomalies—intentionality—Princeton Engineering Anomalies Research (PEAR)—random event generators (REGs)—remote perception—resonance—spatial/temporal independence—subjectivity—theoretical models

I. Prologue

Any attempt to retrace the 26-year path of the Princeton Engineering Anomalies Research (PEAR) program must recognize that this has by no means been a monofilamentary technical endeavor. Rather, the primary scientific strands have been tightly interwoven with a number of philosophical, economical, political, cultural, personal, and interpersonal fibers that have both constrained and enriched the course of research. Some of these components lend themselves comfortably to exposition in an academic journal; others less so, requiring the reader to interpolate between the lines of necessarily sanitized descriptions. Beyond that, it is difficult to sequence the reportage to follow the courses of the individual elements coherently, while still retaining some chronological fidelity to their composite evolution. Notwithstanding, whatever intellectual and intuitive wisdom has been acquired in this program has devolved from the dynamic, synergistic intertwinement of its multivaried threads of past, present, and future contexts and perspectives, rather than from any particular one of them, *per se*, and it is to this interplay that this article is addressed. Indeed, this evolution could well be represented from a variety of other perspectives wherein a philosophical, psychological, mystical, biographical, or historical tone would dominate the reportage, with the technical and analytical details interwoven as credibility embellishments, as is commonly done in popularized addresses to the topic.

For our *Journal of Scientific Exploration* (JSE) readership, however, this article will retain a basically scientific perspective, albeit one requiring greater breadth and depth to accommodate the empirical correlates than is typically allowed in most other technical areas. To minimize the dimensions of this paper, we shall make frequent reference to our original attempt to display the inescapable multidisciplinarity of this topic in the book *Margins of Reality: The Role of Consciousness in the Physical World,* first published in 1987.(1) While the empirical results, theoretical models, and conceptual interpretations presented therein have been greatly extended by two decades of subsequent work, much of the ancillary contextual material remains quite valid to more contemporary renditions. Similarly, extensive reference will be made to the numerous archival publications and technical reports written over the course of the program, many of which now may be downloaded from our website ⟨http://www.princeton.edu/~pear/⟩.

II. Genesis

As recounted in more detail in *Margins*, the establishment of the PEAR program was stimulated by some rudimentary studies involving a microelectronic random event generator (REG), undertaken in an undergraduate independent project supervised by one author (R.J.) over the period 1977–79. The enigmatic mind/matter results that surfaced in the course of that project raised provocative epistemological implications for the basic sciences, pragmatic implications for technological applications, and metaphysical implications for personal, interpersonal, and cultural belief systems and behavior. Clearly, more substantial investigation was predicated, but the prospect of mounting a research program of a scale and character competent to render definitive answers to the host of strategic and philosophical questions swirling around such an investigation was daunted by a recalcitrant university administration and a dearth of scholarly colleagues willing and competent to collaborate in such an enterprise. More serendipitously, however, there was also at that time a compensatory eruption of intellectual, emotional, and not least, financial encouragement from a number of powerful supporters outside of the university who were unflinching in bringing their stature, influence, and fiscal resources into play (*cf.* "Acknowledgments"). After a tedious period of frequently frustrating and occasionally amusing negotiations within the university, the program was authorized and officially launched in June 1979. Minimal laboratory space was carved out of a storage area in the basement of the Engineering School complex, which to this day remains the storied technical and social home of the fully international PEAR operations. Recruitment of appropriate staff was begun, an initial sequence of experiments was designed and implemented, and a stream of data began to flow.

Early on, the title "Princeton Engineering Anomalies Research" was selected to emphasize that this program was (a) academically based; (b) impelled by, and primarily addressed to, technological implications; (c) focused on initially inexplicable physical phenomena; and (d) pursued *via* rigorous scientific methods. (In a classic piece of Jungian synchronicity, while the decision to adopt this nomen and its acronym was being debated at a private lunch in a small coffee shop, the authors noticed that the salt and pepper shakers were in the shape of pears, that the salad involved pears, and that the dessert menu featured pear cake. (Nor was the linguistic similarity of the label to its intellectually bonded *pair* of authors overlooked in its adoption.)

All of the technical, philosophical, and political steerage of the program through its birth pangs and infancy was shared in close dialogue between the two authors, even before the latter (B.D.) began her formal appointment as Laboratory Manager. During this same period, the Director (R.J.) endeavored to maintain some scholarly credibility and administrative authority in his tetravalent roles as Dean of the School of Engineering and Applied Science, Professor of Aerospace Sciences, director of a major research program in advanced space propulsion systems, and leader of this embryonic engineering anomalies research enterprise. From its conception, it was agreed that the overarching purpose of the program was to be a scientifically rigorous, empirical and theoretical study of anomalous interactions of human consciousness with random physical processes, with particular attention to the following hierarchy of questions:

1. Are such mind/matter anomalies legitimate?
2. Are they amenable to systematic scientific investigation?
3. What is their scale?
4. Do they display characteristic structural features?
5. What are their primary physical correlates?
6. What are their primary subjective correlates?
7. What is their empirical replicability?
8. Can theoretical models be constructed?
9. What are their scholarly interfaces with other technical disciplines?

10. Are they related to other creative or aesthetic domains?
11. What are the implications for scientific methodology?
12. What pragmatic applications can be foreseen?
13. What are the broader cultural or metaphysical implications?

The subsequent course of this program has attended to this sequence of queries rather closely and, to varying degrees, substantial responses to each of them can now be made with some confidence, as outlined throughout this article.

To address this matrix of questions, it also was agreed at the outset that the research agenda should comprise three synergistic parts:

1. Experimental studies of the interaction of human operators with a broad variety of devices that embodied some forms of random physical processes, with the goal of assessing how much information, in the classical objective sense, could be imparted by anomalous means to their output data streams.
2. Complementary experimental studies of the remote perception genre, to assess the degree of information about specified physical sites that could be acquired by a human percipient by other than physiological sensory means.
3. Construction of theoretical models that could dialogue with both classes of experiments, to aid in their design, evaluation, and interpretation, and eventually to enhance fundamental understanding of the phenomena.

Throughout the history of the program, the symbiotic technical and philosophical reinforcement of these three components has continued to be demonstrated and utilized, and has remained an important aspect of the phenomenological and theoretical representations.

It was clear from the start that the inescapably multidisciplinary character of the topic demanded a comparably multidisciplinary staff, and such was sequentially recruited and phased into an atypical but remarkably coherent and effective research team. In addition to a director drawn from the basic and applied physical sciences and engineering, and a laboratory manager trained in developmental psychology and broadly cognizant of philosophical, spiritual, and mystical traditions, the laboratory staff has comprised a selection of psychologists, physicists, engineers, and social scientists. Some of these have been associated with the program for many years, others have been more transitory, but all have contributed in important ways to the effectiveness of the operations and to the growth of understanding.

III. Early Results

The original human/machine experiments performed in the young PEAR program employed a first-generation random event generator (REG) based on a commercial noise diode, and were performed by only a few human operators, none of whom claimed exceptional abilities. Suitably conditioned, this noise

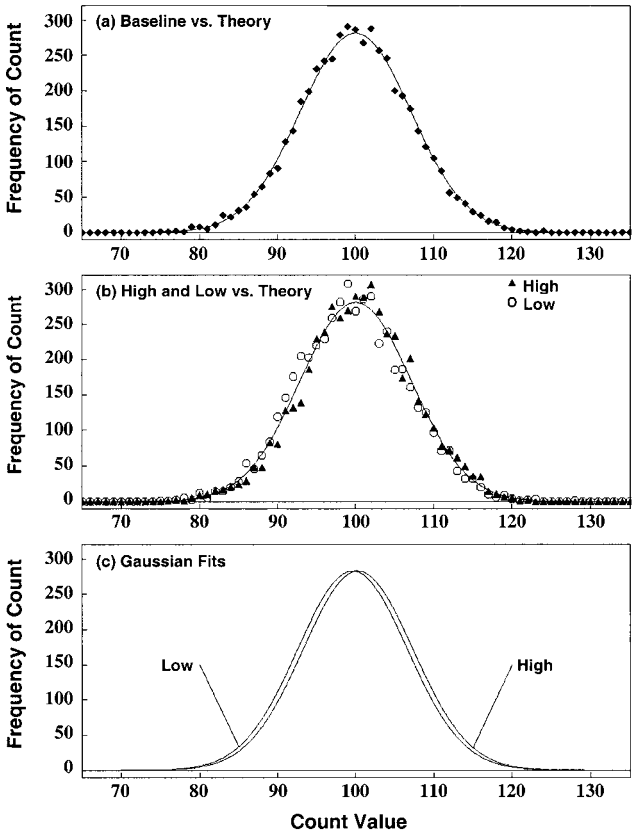

Fig. 1. First formal results of one operator's intentions on REG output count distributions, superimposed on theoretical chance expectation: a) baseline data; b) high- and low-intention data; c) best binomial fits to high and low data.

source emitted data streams of 200 binary digits per experimental trial, which under calibration conformed precisely to the Gaussian representation of random combinatorial samples.[(2)] The operators attempted, following pre-recorded intentions, to induce the device to yield higher, lower, or undeviated (baseline) mean values of its output distributions.

The first formal batch of data produced by the most prolific of these operators under these rigorous experimental conditions proved seminal to the entire future course of the program. As displayed in Figures 1a through c and Refs. 1–3, it was indisputably evident that this operator had succeeded in shifting the mean of the high-intention (HI) and low-intention (LO) outputs in the intended directions, while the null-intention or baseline (BL) data were indistinguishable from calibration or theoretical chance expectation. The anomalous effect sizes were quite small, of the order of 0.002 bits/bit deviation from chance, but even for this rather small database (5000 trials per intention), the statistical significance of the

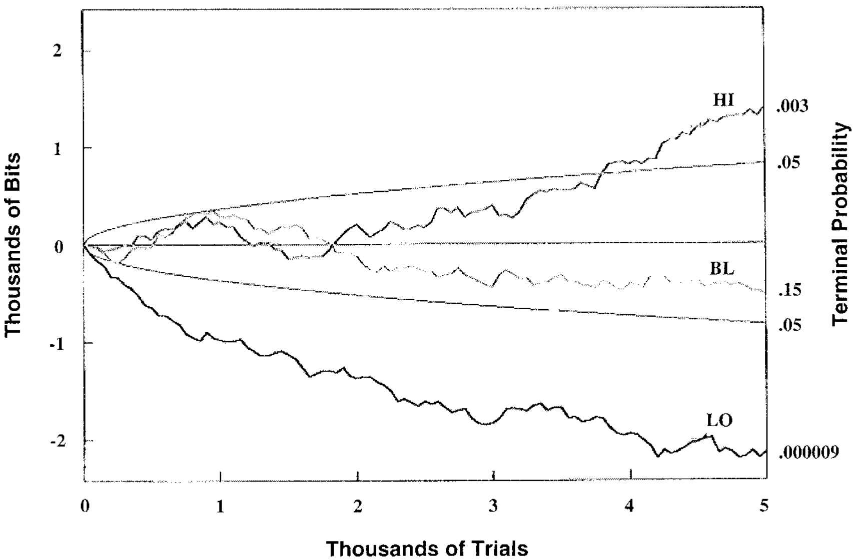

Fig. 2. Same data as Figure 1, displayed as cumulative deviations of trial mean values, *vs.* accumulated number of 200-sample trials: high intention (HI); low intention (LO); null intention or baseline (BL). (The parabolas on this and subsequent figures are the loci of the 0.05 chance probabilities traditionally used as statistical significance criteria.)

HI – LO separation was inescapable, of the order of 10^{-6} likelihood by chance. The patterns of progression of the HI, LO, and BL mean shifts as the database accumulated were best displayed as cumulative deviation plots, like those sketched in Figure 2 for this same body of data.

These initial results immediately raised a ladder of derivative questions:

1. Could this same operator continue to produce anomalous correlations with a high degree of replicability?
2. Could other operators produce similar effects?
3. If so, how did their individual results differ?
4. Could structural features of their output distributions other than the means be affected?
5. What personal characteristics of the operators were relevant?
6. What operator strategies or protocol variants were most effective?
7. How important was the mode of feedback provided to the operators?
8. Were the details of the random source important to the occurrence or scale of the effect?
9. What were the spatial and temporal dependencies?
10. Could pseudorandom or other deterministic sources be similarly affected?
11. What forms of theoretical model could be posed to accommodate such effects?

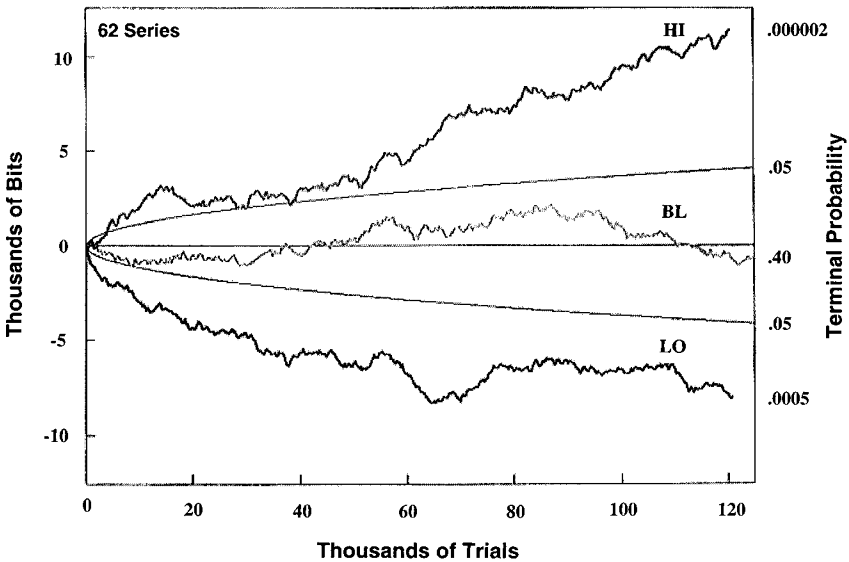

Fig. 3. Cumulative deviations of all mean shifts achieved by the same operator as Figure 2 over entire database of some 125,000 trials per intention.

Question #1 has been answered affirmatively over many subsequent years of continuing participation of the original operator in this and other closely related REG experiments. For example, Figure 3 shows the cumulation of results of some 125,000 trials, each comprising 200 sampled bits in each of the three intentions, acquired by this same person over the first decade of the PEAR program. Note that although the initial rates of anomalous correlation with the directions of intention have not been fully sustained, the overall secular progress of the deviations from theoretical mean expectation, calibration, or baseline results over this huge composite database have continued to carry the HI, LO, and HI – LO terminal probabilities well beyond any reasonable chance interpretation ($p_{HI} \approx 2 \times 10^{-6}$; $p_{LO} \approx 5 \times 10^{-4}$; $p_{HI\,-\,LO} \approx 10^{-8}$).

The second question has been addressed over the same period by the deployment on the same experiment of 90 other volunteer operators, all anonymous and claiming no special talents, with the results displayed in Figure 4. From their composite database, three features have emerged: a) statistically significant deviations of the HI ($p \approx 0.0004$), LO ($p \approx 0.02$), and HI – LO ($p \approx 0.0001$) data from chance expectation have been maintained; b) the average effect sizes in this database are slightly smaller than those of the original operator; and c) the baseline data also display a positive secular drift which, while not statistically significant (two-tailed statistics required in absence of an intended direction), nonetheless hints at more subtle operator influences. Throughout this extended period of experimentation, the unattended calibration data continued to fall well within chance behavior.[4]

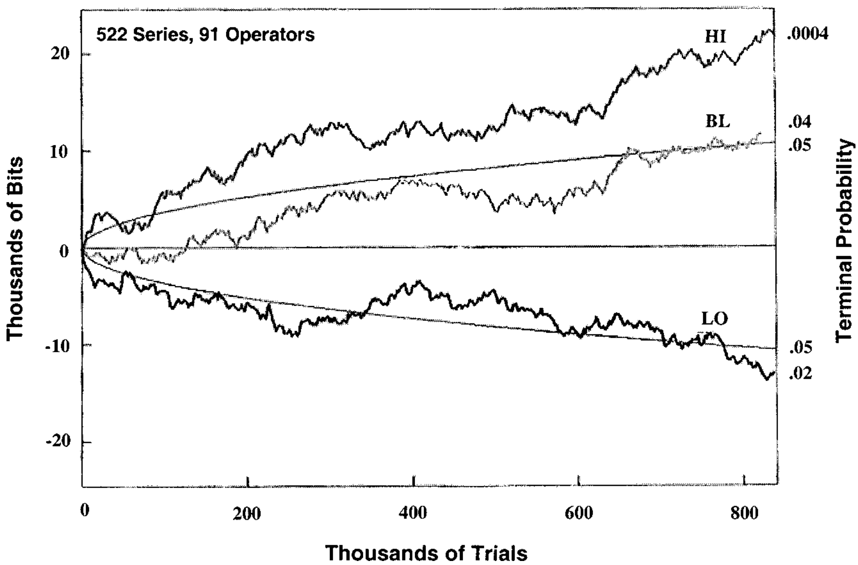

Fig. 4. Cumulative deviations of all mean-shift results achieved by all 91 operators comprising a database of some 2.5 million trials.

Study of the remaining nine issues has required subdivision of each of the questions into various subordinate queries, predicating correspondingly dedicated experimental protocols, equipment, and/or data analyses. These will be sketched sequentially in later sections.

* * * * * *

Over the same early period of human/machine experimentation, we also initiated a sequence of remote perception experiments which largely followed the successful protocols developed by B.D. at her previous institutions,[(5)] but with an important additional feature. Namely, although the first results of these experiments, like their predecessors, displayed many striking impressionistic correlations between target features and the percipient transcripts, and while human judging evaluations of the overall similarities of the perceptions to the targets compounded to impressive ranking statistics, it nevertheless became clear that a more feature-specific, quantitative, analytical judging procedure would be desirable. The basic concept selected for this effort entailed the use of a finite net of binary descriptors which could be applied to both the targets and their perceptions, the correspondences of which then would provide the basis for quantitative scoring of each perception attempt.[(6)] The evaluation of such analytical scoring techniques rapidly acquired a life of its own, with many variants of the descriptor lists, response options, normalization strategies, and descriptor effectiveness evaluations attempted.[(7)] Utilizing these methods, a range of possible phenomenological correlates was explored, such as the manner of target selection, the number of percipients addressing the target, the distance between the percipient and the target, and perhaps most importantly, the time interval between the percipient's effort and the agent's presence at the target.

Details of the empirical and analytical remote perception studies, their relationship to the human/machine experiments, and the insights they have provided on the roles of uncertainty and information in such a hybrid subjective/objective experimental entwinement will be presented in Section VII of this paper. Only to be noted at this point is that these results also have displayed an array of indicators of anomalous information acquisition similar to, in fact larger than, those apparent in the human/machine information-addition experiments. Indeed, despite the superficial dissimilarities between the remote perception and the human/machine protocols, on several occasions particularly bemusing effects in one of them have prompted examination of comparable aspects of the other. For example, the remarkable insensitivity of the remote perception results to both the distance of the target from the percipient, and to the time interval between the perception effort and the target visitation by the agent, led to a parallel series of remote, off-time human/machine experiments, whose yield proved comparable to that of the corresponding local experiments (*cf.* Section V-c).

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Consistent with its charter agenda, the program recognized from the start that it could not qualify as a fully scientific endeavor in the absence of some form of theoretical model, however crude and abstract that might first be, to engage in dialogue with the experimental results. The extensive historical and contemporary literature of attempts to model psychic phenomena in psychological, philosophical, metaphysical, physical, geophysical, and mathematical terms[(8)] was thoroughly explored, and found to be seriously deficient in accommodating the empirical data, and conceptually unconvincing. It became clear that only major metaphoric extrapolations of existing formalisms that could encompass the subjective, as well as the objective, aspects of the human/machine and remote perception interactions held any hope of providing explicative and predictive capability. As a first attempt, we proposed appropriation of observational quantum mechanics as a philosophically consonant concept base.[(9)] While this sacrilegious extrapolation raised considerable bleating from the canonical physical science community, it actually has proven enduringly helpful to our own endeavors in conceptualizing the phenomena, designing the experiments, and interpreting their results. Further details of this model, and of others that have subsequently been developed, are presented in Section VIII.

IV. Ancillary Strands

As mentioned earlier, in parallel with the development of the technical substance and style of the research program, a number of interpersonal and political fibers woven from within and without the university have influenced the evolution of the program, some productively, some to its detriment. Among our immediate faculty and administrative colleagues, the initial suspicion and resistance that attended the birth of the project has diffused over the years into a somewhat milder, albeit more widespread and generalized, disparagement. In some cases this has been expressed by covert ridicule, in others by grudging concession of academic freedom, and in others by uneasiness in public discussion of the subject. Yet, some private interactions with these same people have led to shy confessions of personal interest, rooted in past experiences deemed too embarrassing for more public acknowledgment. More despicable have been a few sanctimonious attempts by self-styled critics to discredit the work among their audiences of students, administrators, or less technically cognizant colleagues. Fortunately, and to their great credit, many of the recipients of this derisive commentary have seemed largely to recognize its vacuousness, and to prefer to assess the issues for themselves. (For the musically inclined, a remarkably apt theme song for this undercurrent of pseudo-scholarly sabotage would be the famous aria "La Calumnia" from Act 1 of Rossini's opera, *The Barber of Seville*, wherein one of the villains suggests to another that the hero can be discredited by a few slanderous innuendoes, amplified by the inevitable public propensity to sanctimonious tongue-clucking.)

Personally unpleasant as this naysayer rhetoric has been, its more serious consequences have been the inhibition of what could have been highly productive scholarly collaborations, particularly with a few other engineers, physicists, psychologists, and philosophers of science for whose own research this work has held considerable relevance. It also has precluded the establishment of a viable curriculum of instruction for interested undergraduate and graduate students, and discouraged some potential financial donors who have aspired to fund truly interdisciplinary study of these phenomena at a university of this stature. For example, at one point we attempted to facilitate some scholarly colloquy between the PEAR program and other potentially relevant faculty projects in engineering, psychology, and philosophy *via* the establishment of a "Human Information Processing Group." Initially funded quite handsomely by a philanthropic foundation, it went through the administrative motions of appointing staff and effecting procedures to catalyze interactions among several researchers who were individually addressing various pertinent topics in cognitive science, robotics, expert and complex systems, as well as our own engineering anomalies. Unfortunately, the traditional epistemological, tactical, and jurisdictional boundaries separating these topics never were effectively penetrated, and the presence of the anomalies work in the mix proved too much of an anathema to some of the participants, with the result that the interaction did not flourish intellectually and eventually was abandoned by its sponsor. Its only enduring accomplishment was the establishment of an undergraduate course in human/machine interactions which became quite popular with the students and continues to be team-taught to a full house each year. (In all of this, we have had frequent recourse to Friedrich

Nietzsche's injunction to love our enemies because they bring out the best in one, or to its corollary that what does not destroy us, makes us stronger.)

Lacking other viable possibilities for effective interdisciplinary collaborations on our campus, we undertook to recruit, organize, fund, and activate an elite group of outside colleagues from this country and abroad, each of whom was a recognized authority in some conventional discipline, but also shared a common interest in the role of consciousness in the establishment of physical reality. Named the "International Consciousness Research Laboratories" (ICRL), this consortium originally comprised eight research fellows who collectively combined perspectives from the physical sciences, life sciences, engineering, anthropology, archaeology, psychology, philosophy, and medical practice. Eventually this organization was chartered as a 501(c)(3) non-profit public philanthropy, overseen by a five-member Board of Directors, in which format its agenda has converged to three principal activities: an array of collaborative research projects; plenary meetings to exchange research results and new ideas; and the provision of internship opportunities for young scholars. More recently, it has fused its intellectual, financial, and administrative resources with a select group of some 60 gifted young scholars committed to interdisciplinary research and dialogue on the centrality of consciousness in all areas of human experience. Referred to as "The PEARtree," since the majority of its members have spent time at PEAR as volunteers or interns over the years, this community continues to constitute an important supplement to the research and educational outreach of ICRL and of PEAR itself. (More details of the ICRL tree structure and activities can be found on the website: ⟨www.icrl.org⟩).

Further constraints on the propagation of research results into other scholarly communities have been imposed by some professional societies and their vaunted archival journals. Attempts to publish basic research articles to stimulate critical colloquy have been met with categorical rejection without any formal reviews, on flimsy grounds of "inappropriate topic for this society;" "insufficient membership interest;" or "no established peer group." On one occasion an editor responded with the quip: "When you are able to transmit this text to us telepathically, we shall consider it seriously." One notable early exception to this dreary drill was the acceptance in 1982 by the *Proceedings of the Institute of Electronic and Electrical Engineers* of a major review article entitled "The Persistent Paradox of Psychic Phenomena: An Engineering Perspective."[8] It was followed by a vigorous exchange of letters in the same journal, and subsequently our laboratory received thousands of requests for reprints of this article. Yet, when we inquired of the managing editor some years later whether he would entertain a sequel, he responded that his board had embargoed any such proposition on the grounds of a lack of interest on the part of their readership. A second positive exception was the publication in 1987 (after some 15 separate peer reviews!) by the *Foundations of Physics* of our aforementioned theoretical model entitled "On the Quantum Mechanics of Consciousness with Application to Anomalous Phenomena."[9] But again, despite the frequent subsequent citations of this paper, further submissions on any other aspects of our work were subsequently discouraged on the basis of the "irrelevance" of the topic to physical science.

Over the same period, many other reputable scholars of anomalous physical phenomena had encountered similar exclusions from established channels of scholarly dissemination, and it was inevitable that these outcasts eventually would band together to establish their own forum for critical representation and discussion of their work. This manifested in 1978 as our Society for Scientific Exploration (SSE) and its *Journal of Scientific Exploration*. Under the pioneering leadership of Peter Sturrock and a small group of Charter Members, SSE has grown slowly but steadily, not only in the size and quality of its membership and its journal, but in the maturation of its purposes and its strategies for achieving them. In particular, its original primary goal of legitimizing anomalistic research in the eyes of the established scientific communities gradually has become superseded by a growing confidence that the bodies of work encompassed by the Society actually are establishing several new frontiers of future science, rather than merely challenging its past boundaries. As a strategic corollary to this premise, the Society has placed progressively more emphasis on attracting and providing intellectual resources for interested young scholars, *vis-à-vis* courting the scientific Old Guard. In this evolution of SSE, and thereby of the world of canonical science, PEAR has endeavored to play some role, and has certainly benefited from that effort. Most notably, the peer-reviewed journal and the annual conferences of the Society have provided productive scholarly forums for critical consideration of our work and its representation to the several scholarly communities that convene under the SSE panoply.

Also counterbalancing the surrounding muddy puddles of negativity has been the spontaneous emergence of major intellectual, financial, and moral support of the PEAR program by powerful leaders from the academic, industrial, philanthropic, and government sectors, who unflinchingly have placed their own reputations at risk to assert the intellectual and pragmatic importance of work such as this. Two university presidents, two captains of industry, several foundation heads, three Nobel laureates, two congressmen, an undersecretary of defense, and an international head of state at one time or another have risen in public defense and support of this program, and the enduring confidence and friendship of people of this stature has been at least as precious to us as their more tangible contributions. With particular reference to the governmental interfaces, from time to time numerous individuals from various policy-level offices in the intelligence, defense, basic research, space, legislative, and executive branches have displayed interest in PEAR's work. Our inability to accommodate classified projects or information, and our commitment to maintain student access and free publication, necessarily have restricted these dialogues somewhat, and have precluded them as sources of funding, but we nonetheless have given invited presentations at many federal agencies and laboratories, and on one occasion, two high government officials visited our university president personally to assure him of the pertinence of our program to the nation's long-term interests.

Another constituency that has required particularly careful handling has been the public media. The immense reach of this establishment in disseminating information and attracting widespread interest can be severely compromised by its generic tendencies to exaggerate, distort, and sensationalize scholarly material, and through several frustrating experiences we have learned to be highly selective and demanding in any media representations. At one point it became necessary to add to our staff a ''Communications Director,'' one of whose major responsibilities was to screen media overtures and restrain presentations to some level of intellectual and conceptual relevance and sanity. Even so, over the years scores of literary, radio, and video presentations have been propagated. Those that were done well have broadened our pool of public interest, attracted new operators, and stimulated financial support. Those that were less well styled have had to be written off as transitory embarrassments.

The program also has attracted interest from other public domains such as health care, education, business, theology, art, and philosophy, wherever the practitioners and proponents have been able to grasp the relevance of our consciousness-correlated anomalous physical results for verification and comprehension of their own heretofore heuristic and intuitive experiences and activities. Most of these interfaces have proven profitable in both directions, *i.e.*, any validations and encouragement we have been able to provide these practitioners have been more than compensated by insights we have gleaned from discussions of their own perspectives, experiences, conceptualizations, and heritages.

These several forms of professional and public representations, along with more spontaneous word-of-mouth propagation of the laboratory's activities and reputation, have stimulated a blizzard of requests for visits to our facilities; involvement as operators; collaborations with other programs; presentations to academic, professional, business, and community groups; attention to personal reports of spontaneous anomalous phenomena; sharing of personal ideas, plans, and convictions; and confrontations with a host of skeptical challengers. Sorting this plethora of positive and negative attention down to a level and quality that would not excessively impede the daily activities and intellectual headway of the research has been a demanding burden, and a far from precise process. In many cases, solicitations from individuals bearing impressive credentials and claiming intense scholarly interest have manifested as naïve, ineffective, or troublesome digressions that have consumed substantial program resources with little derived benefit. Yet, in other cases, superficially less promising visitors have unexpectedly become productive operators, useful administrative volunteers, and stimulating professional colleagues.

Most precious among this latter category has been the growing number of students and other visionary young people who, *via* a variety of stimuli, have been drawn to involvement in our program, either directly or remotely. Their openness, idealism, and vigor have been the least cowed by the prevailing intellectual and cultural recalcitrance, and they have been the most venturesome breakers of fresh conceptual ground in their own scholarly explorations. Despite the absence of any curricula, degree-granting programs, or encouragement by their canonical faculties and supervisors, these students somehow have found their way into our laboratory and literature to experience for themselves in various less formal ways the spirit and substance of the ongoing intellectual quest. For some it has been no more than a brief visit or two; for others it has been involvement as operators; for others, an informal internship, or a freely chosen piece of independent research. Several of these student projects, like the one that initially stimulated the establishment of the program, have led to viable and instructive formal experiments. Few of these people have received any financial compensation for their work, and most of them have encountered some share of the skeptical derision that has hovered around the program and its topics. Notwithstanding, a large proportion of them have retained on-going contact with the laboratory, and have shown clear evidence of having been significantly influenced by it. Beyond the SSE Young Investigators and ICRL/PEARtree initiatives mentioned above, we have presided over the operation of two successful summer academies for such young participants, which in turn have led to numerous research collaborations, publications, an electronic network for PEAR-conditioned scholars, and, most importantly, a growing family of peers who share the vision of an emerging science of the subjective. We are persuaded that on the branches of such a tree, the fruits of essential future understanding and creativity will emerge, and the propagation of the wisdom embedded in this topic will be borne.

V. Salient Correlations in Human/Machine Anomalies

a) Operator-Specific Discriminations

With these peripheral fibers thus introduced into our PEAR tapestry, let us return to the list of secondary questions that emerged from the first phase of successful experiments described in Section III. For this purpose, we shall make no attempt at a full or sequentially systematic review of the many technical, psychological, and environmental parameters that actually have been studied over the course of the program. Rather, we shall focus on those discriminators that have displayed strongly anomalous correlations with the machine outputs (or strongly anomalous lacks of correlation therewith), and thus can contribute most incisively to theoretical conceptualization and modeling, the design of latter-generation experiments, and the improvement of understanding of the phenomena. And again, we shall refer heavily to our previous publications on these topics.

In reviewing even this restricted menu of acquired insight, it is important to remember throughout that we invariably are dealing with very small anomalous effects that are superimposed on much larger, broadly diffused random distributions. In fact, in most of these cases our data themselves qualify as essentially random distributions whose mean values are displaced only slightly from those of a perfectly balanced binary combinatorial (*i.e.*, one derived from a sequence

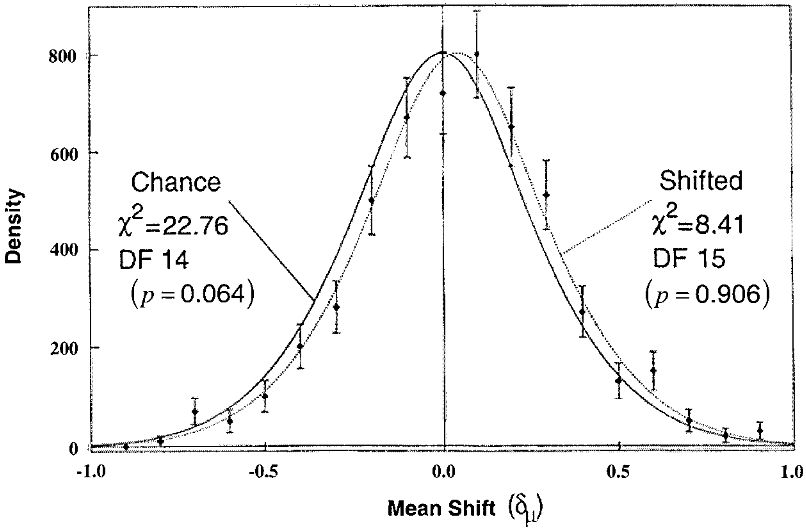

Fig. 5. Distribution of HI – LO mean-shift separations for the same 91-operator database as Figure 4, superimposed on theoretical distributions with means of $\delta_\mu = 0$ ($p_b = 0.500000$) and $\delta_\mu = 0.042$ ($p_b = 0.500105$).

of binary events characterized by an elemental probability of precisely $p_b = 0.5$). The point is illustrated by Figure 5, which superimposes typical REG anomalous effect sizes on theoretical distributions for $p_b = 0.500000$ and for the best-fit case of $p_b = 0.500105$.[4] The corresponding chi-squared (χ^2) goodness-of-fit values for the distribution of experimental data significantly favor the latter model, but no further discrimination of the data structure is possible in this format. However, a more detailed and quantitative display of this output characteristic may be obtained by plotting the deviations of all of the individual count values from their corresponding $p_b = 0.5$ chance expectations. As illustrated in Figures 6a and b, within statistical expectation the fractional displacements are linearly arrayed, the most parsimonious interpretation of which is that the anomalous mean shifts are achieved simply by changing the binary bit probability to $p_b = 0.5 + \varepsilon$, where ε denotes a small adjustment characteristic of the particular experiment and operator.[10]

A second important recognition for all of these explorations is that the statistical merit (Z-score) of any body of anomalous results scales linearly with the prevailing average effect size, *and* with the square root of the number of data samples (*e.g.* bits, trials, runs, series, *etc.*). This feature is utilized in Figure 7, where individual operator data values are plotted on orthogonal coordinates of mean shift and square root of number of trials.[4] In this frame, the loci of constant *Z*-scores or corresponding probabilities are nested hyperbolas like those shown. It follows that progression outward to higher statistical significance can be achieved *either* by larger effect sizes, or by larger databases, or by some

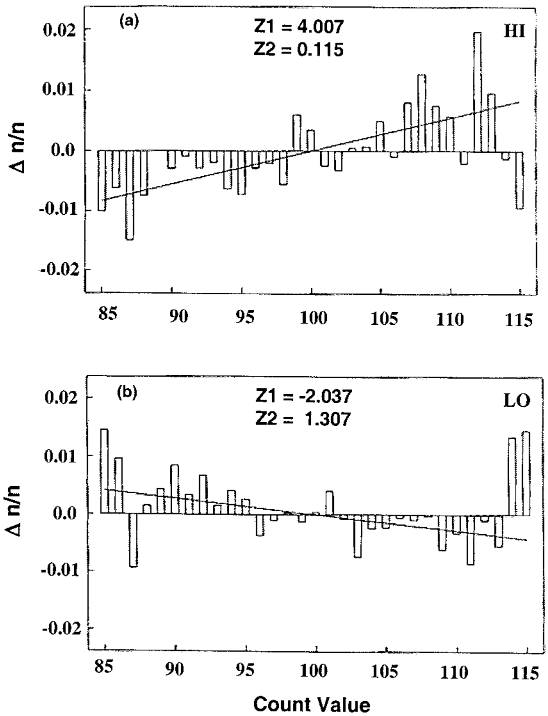

Fig. 6. Fractional deviations of individual count populations from their chance expectations, with superimposed linear fits and corresponding first and second regression coefficients: a) HI data; b) LO data.

combination thereof. Alternatively stated, operators displaying relatively modest effect sizes nonetheless can attain high statistical significance by sustaining them over very large databases; operators with small databases must achieve much larger effect sizes for their results to qualify as anomalous.

For the two reasons just cited, it is extremely difficult, and potentially quite misleading, to attempt to rank the effectiveness of particular operators on the basis of anything but very large individual databases. For smaller datasets, any anomalous increments are inextricably superimposed on much larger, intrinsically unspecifiable portions of the underlying chance distributions, so that any attained score may entail only a slight increase, or even a slight decrease, of an already high, low, or mid-range chance value. Hence, only over very large individual or collective datasets can convincing anomalous trends emerge. This recognition has prompted the identification of a particularly precious subset of our participants, termed "prolific operators," whose dedication to the work has inspired them to produce large enough databases that inter-operator comparisons and structural analyses of their results make some statistical sense. For all other operators, the only recourse is to pool their results in search of composite trends,

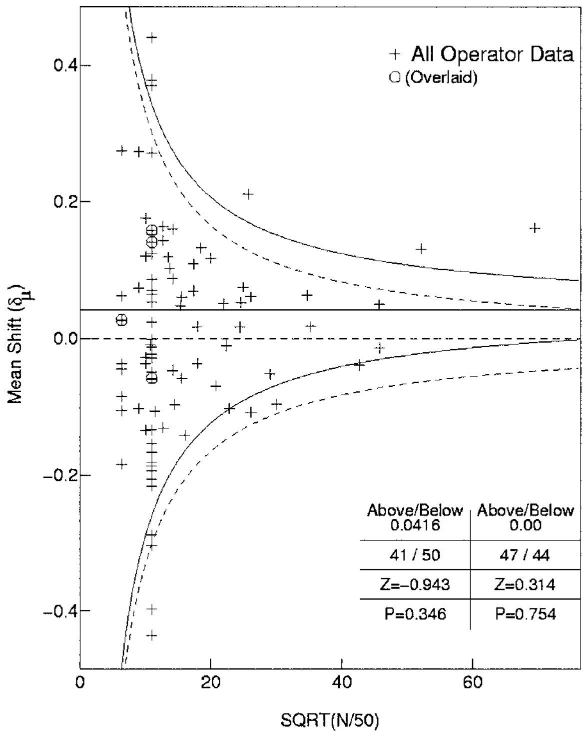

Fig. 7. Deployment of 91 individual operator HI – LO mean-shift separations as a function of database size. The inset tables summarize the balance of success of the operator HI – LO performances in the intended directions, compared with both the theoretical chance ($\delta_\mu = 0$) and composite empirical ($\delta_\mu = 0.0416$) values.

while guarding both procedurally and analytically against optional stopping artifacts that could prejudice the smallest datasets.

With these caveats in place, closer examination of graphical displays of data such as Figure 7 can yield some insights into the operator-specific characteristics of the anomalous effects alluded to in queries #3–7 of Section III. For this particular body of data, for example, first to be noted is that of the 91 operators contributing to this database of over 1.5 million experimental trials, the results of only six lie outside the 0.05 confidence hyperbola in the intended direction of HI – LO separation, while two others fall outside in the direction opposite to intention, compared to the roughly 4.5/4.5 expected by chance. This hardly overwhelming result is complemented by the observation that 47 of the operator points lie above the chance mean and 44 below, which is also statistically unimpressive. Notwithstanding, the composite array of these 91 operator achievements has its mean value shifted from zero to 0.041, which is a hugely significant aberration ($p = 7.0 \times 10^{-5}$). Thus, such data assert that the collective anomaly is not primarily driven by distinguishable "superstars," but rather by a collective array of inextricably small individual effects, achieved over many large datasets.

Beyond this observation, however, there are other important anomalous structural features resident in these data. As tabulated in the inset to Figure 7, only 41 of the 91 points lie above the *shifted* overall mean value of 0.041; 50 lie below, constituting a clear asymmetry in the shifted distribution. It turns out that this distortion is keenly dependent on the *gender* of the operators. Figures 8a and b display the same data in the same format for the separate pools of male and female operators. It is visually evident that these are not the same distributions. Rather, the male data compound to a modestly significant mean shift in the intended directions, achieved *via* a reasonably balanced distribution. The female data, in contrast, are quite bimodal, with their highly significant overall mean shift driven by a relatively few prolific operator positive results, struggling against a larger number of lesser negative values.

This stark "gender effect" can be statistically quantified by an elementary χ^2 analysis, as presented in Table 1, which breaks out the HI – LO mean-shift effects (Z_Δ), and the operator performance scatter with respect to the chance mean (χ^2_Δ) and with respect to the shifted mean ($\hat{\chi}^2_\Delta$) for various permutations of All/Male/Female, prolific/non-prolific operator pools. Clearly the anomalous mean shift of the "All" database is driven primarily by the prolific female operators, who also scatter their individual results, both with respect to the chance mean and with respect to the shifted mean, to an extraordinary degree. By these same criteria, the male performance, although milder, is much more consistent with intention.

The relevance of the gender factor has also been illustrated by bodies of *ad hoc* experimental data produced by pairs of operators working in concert. In these "co-operator" studies, it has been found that two operators of the same sex tend to produce results indistinguishable from chance, or even slightly opposite to intention. In contrast, operators of opposite sex tend to produce positive effects significantly larger than chance, indeed substantially larger than those characterizing the individual operators working alone. Yet more striking has been the observation that if the opposite-sex partners are emotionally involved ("bonded pairs"), their collective effect sizes are nearly seven times larger than those attained by the same operators working alone[(11)] (*cf.* Figure 9).

Results such as these prompted an extensive retrospective assessment of gender disparities across nine distinct human/machine experiments performed in our laboratory over the period 1979–98.[(12)] Without attempting to report all of those findings here, we simply note that their inescapable conclusion, supported by many subsequent experiments, was that operator gender is a demonstrably pertinent parameter in virtually all human/machine interactions of this type, thereby implying that such gender disparities must be acknowledged in any conceptual model of the phenomena. In particular, we have repeatedly found that although the female operators tend to provide larger individual databases, the males display significantly stronger correlations of mean shifts with their pre-recorded high and low intentions, relatively symmetrically displaced with respect

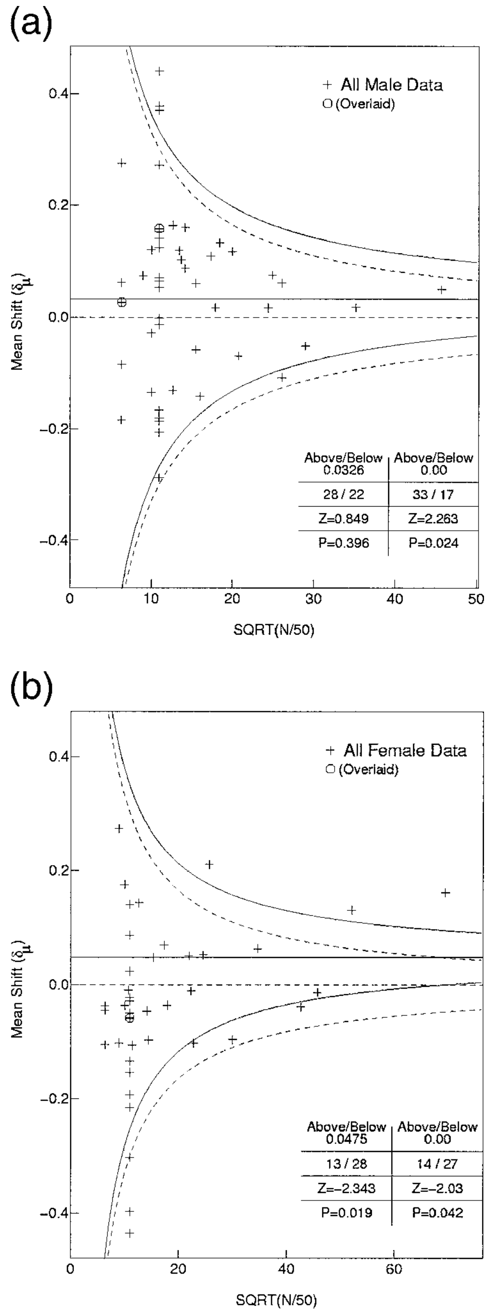

Fig. 8. Same display as Figure 7: a) male operators ($\delta_\mu = 0.0326$); b) female operators $\mu = 0.0475$).

TABLE 1
HI – LO REG Data, By Operator Groups

	N	Z_Δ (p)	χ^2_Δ (p)	$\hat{\chi}^2_\Delta$ (p)
All	91	3.81 (6.9×10^{-5})	124.50 (.01)	109.99 (.07)
Males	50	1.87 (.03)	44.85 (.70)	41.33 (.77)
Females	41	3.38 (3.6×10^{-4})	79.66 (2.8×10^{-4})	68.22 (.0036)
Prolific	20	4.15 (1.7×10^{-5})	63.85 (1.8×10^{-6})	46.64 (4.0×10^{-4})
Non-prolific	71	0.57 (.28)	60.65 (.80)	60.32 (.79)
Prolific males	9	0.70 (.24)	7.36 (.60)	6.86 (.55)
Prolific females	11	4.54 (2.8×10^{-6})	56.49 (4.1×10^{-8})	35.87 (8.9×10^{-5})

to their baseline results. The female data, in contrast, feature larger effect sizes, albeit strongly asymmetrical and poorly correlated with intention, and larger score distribution variances. Since no such gender differences appear in experiments that yield null overall results, it appears that the successful experiments present both of these classes of response superimposed, *i.e.*, that the data comprise a substantial interior structure driven by operator gender.

Further responses to the brace of operator-related queries #3–7 are necessarily constrained by the data indistinguishability issues already mentioned; by the deliberate decision not to engage in any forms of psychological testing, physiological monitoring, or strategy-training regimens; and by the failure of various ANOVA analyses to identify other strong correlates than those of operator intention and gender.(13) Whereas we may harbor some anecdotal insights or an intuitive sense of what operator characteristics and strategies might be most productive of anomalous data, it would be scientifically misleading to claim any empirical basis for these impressions at this point. Nonetheless, we shall need to revisit these issues

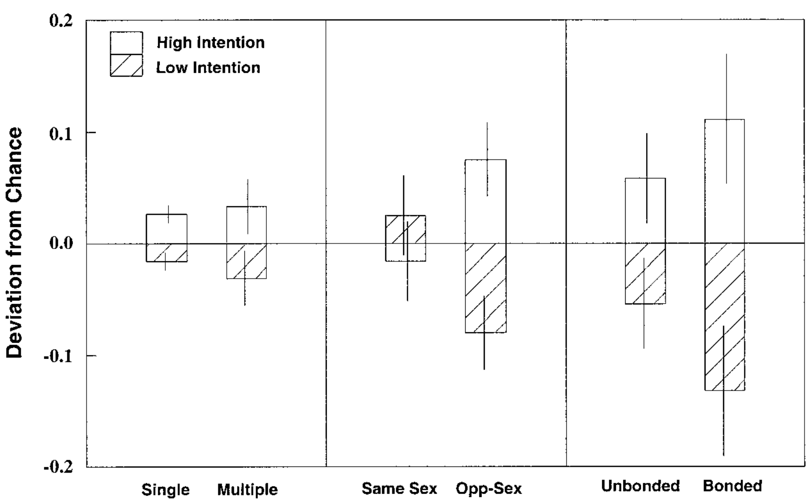

Fig. 9. Effect sizes in various categories of co-operator results (1-sigma error bars superimposed).

in the context of our later discussions of replicability, feedback, and theoretical models, which in turn will predicate more scholarly attention to them.

b) Source-Specific Discriminations

Query #8 in the list of possible correlates refers to the technical details of the random sources which serve as targets for the operator efforts to induce anomalous output behaviors. Over the course of the PEAR research, a great variety of random physical devices and processes have been utilized. Some have involved only minor modifications of the original REG circuitry; others have incorporated different core sources of the microelectronic noise; still others have replaced the physical sources with various pseudorandom generators. In more major excursions, random processes presented by a number of mechanical, fluid dynamical, thermal, and optical apparatuses have been deployed. Some of these experiments could not be stabilized sufficiently against environmental disturbances to allow trustworthy calibration or active experimental data to be obtained, and these had to be abandoned. Some have been set aside until superior technology could be developed and deployed. But many others have survived our stability and randomicity requirements, permitting numerous protocol and feedback excursions. For example, substantial databases have been collected on:

- a large random mechanical cascade of balls through a peg matrix, described in detail below;
- a linear pendulum with an attractively illuminated spherical crystal bob, whose damping rate or symmetry of swing are the targets of operator initiative;
- a small upward jetting water fountain, whose transition from a laminar stream to turbulent burbling, or whose degree of droplet scatter provide the measurables addressed;
- an "ArtREG" experiment wherein an electronic REG controls the relative intensity of two competing images on a computer screen, and the operator endeavors to bring one or the other to dominance;
- a Native American drum, the amplitude or spacing of whose audible beats is driven by an REG box, on which binary auditory streams the operator endeavors to impose more organized rhythmic patterns;
- a small mechanical robot that wanders over a circular table in response to an on-board REG unit, with the operator attempting to influence its angle of exit off of the table, or its time of residence before the exit.

In several cases, our data accumulation capacity has far exceeded our data analysis capacity, and we cannot yet report definitive results on these. Where experiments have been satisfactorily completed and analyzed, they have tended to display similar scales of statistical correlations of anomalous outputs with pre-stated operator intentions, and the same sensitivities to operator gender and co-operator efforts as the benchmark REG studies described earlier. (Our archives maintain

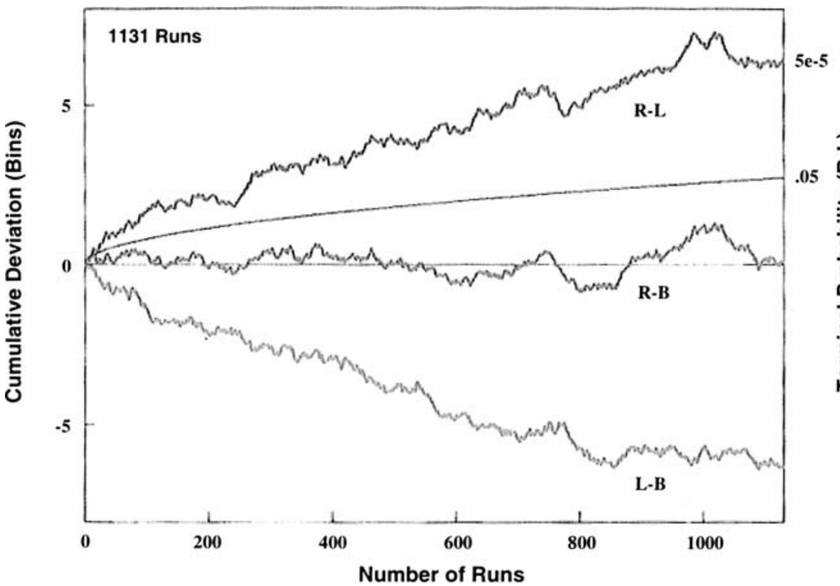

Fig. 10. Cumulative deviation representation of results of Random Mechanical Cascade (RMC) experiments.

a comprehensive ensemble of laboratory notebooks and associated documentations covering all random processors that we have attempted to engage in human/machine experiments in the PEAR laboratory, including details of their technical viability, attractiveness for operators, character of results, and incremental understanding they have provided. This material is available for inspection upon legitimate request by any serious scholars.)

The most extreme example of the broad insensitivity of the anomalous effects to the details of the noise sources has been provided by our extensive experiments with the large facility known as the Random Mechanical Cascade (RMC).[14] Based upon a common statistical demonstration device known as "Galton's Desk," this machine allows 9000 polystyrene balls to drop through a matrix of 330 pegs, scattering them into 19 collecting bins with a population distribution that is approximately Gaussian. As the balls enter the bins, exact progressive counts are accumulated photoelectrically, displayed as feedback for the operator, and recorded directly into the database. Operators attempt to shift the mean of the developing distributions to the right or left, relative to a proximately generated baseline distribution. The overall mean difference of right *versus* left efforts concatenated across the total database of 87 series (3393 runs), has a probability against chance of $<10^{-4}$, with 15% of the individual series significant at $p < 0.05$, and 63% conforming to the intended directions. Prolific operator achievements tend to compound marginally but systematically in cumulative deviation patterns characteristic of the particular individuals and, in several cases, similar to those produced by the same operators in microelectronic REG experiments. Figure 10 presents the RMC results in the same cumulative deviation format as that used for the microelectronic noise sources, with the exception that here the effects are derived from the differences in bin populations among the three intentions in given sets of runs, rather than comparisons with theoretical expectations, which are not readily calculable. Note the same secular progressions of the anomalous effects, embossed by the stochastic random background inherent in this source. Note also the asymmetric pattern of the total differential effects, virtually all of which is attributable to the female operators.[12,14]

Similar consonance of the results acquired from several other qualified random processors has strongly suggested that whatever the fundamental nature of these anomalous effects may be, it functions not so much in the technical dynamics of the sources, *per se*, but in the statistical patterns of information they generate. Therefore, it is with these patterns that the minds of the operators, themselves functioning as information processors, must be interacting. That the former category of information can be specified objectively, whereas the latter clearly involves subjective aspects, must substantially complicate any attempts to model the phenomena, but therein lies their essence.

c) Distance and Time Dependence

The remote perception portion of our consolidated PEAR program that will be reviewed in Section VII, has established that the percipients in such experiments can acquire information about physical targets far removed from their personal locations, without resort to normal sensory channels. More specifically, it has established that the quality of those anomalous perceptions is statistically independent of the degree of physical separation between the target and the percipient, up to global distances. And beyond this spatial independence, these experiments even more remarkably have revealed that the perception efforts need not be performed at the same time as that specified for the target visitation; rather, the scale of the results is also statistically independent of such temporal separation, up to several days, plus or minus. That is, information can be acquired about these targets *before* they are visited by the agent, or even before they are specified, which leads to labeling this body of data ‘‘Precognitive Remote Perception’’ (PRP). Given the recognition that the only basic difference between these consciousness-related anomalies and those of the human/machine experiments is that in the former the participant is *extracting* information from a random source (the pool of potential targets and details thereof), whereas in the latter, information is being *inserted* into a random source (the REG outputs), it seemed reasonable to question whether similar spatial and temporal insensitivities might also characterize the latter.

A carefully controlled program of remote/off-time REG experiments has indeed been pursued, with results strikingly similar to those of the remote perception sequences.[15] Several extensive databases have been acquired for

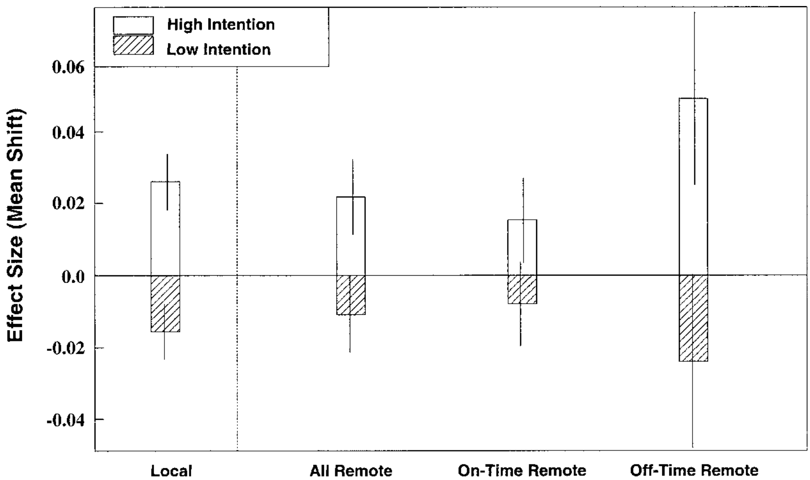

Fig. 11. Local, remote, and off-time REG effect-sizes (1-sigma error bars superimposed).

which the operators and their target machines have been separated by distances up to several thousand miles. In a more extreme variant, the remote operators have exerted their directional efforts up to several hours, or even days, before, or after, the time of operation of the target machines. As displayed in Figure 11, although the smaller size of these databases restrains their overall Z-scores, the intrinsic effect sizes are comparable with, and in the off-time set even larger than, those established in the proximate benchmark experiments. The cumulative achievement patterns appear similar to those of the corresponding local experiments at both the individual operator and collective operator levels, but the gender disparities are less emphatic, an observation which also may provide some conceptual insight. Similar remote/off-time effects have been demonstrated on the analogue RMC and pendulum devices, as well.

This empirical removal of distance and time as correlates of both the human/machine and remote perception anomalies reinforces the suspicion that these two forms of anomaly entail similar mechanisms of information exchange between human consciousness and random physical processes, albeit with opposite vectors, which also may have implications for theoretical modeling of these processes. In either case, the absence of any identifiable spatial or temporal attrition of the anomalous effects calls into question the competence of any prevailing physical conceptualization to encompass the phenomena, forcing consideration of more radical propositions, such as those sketched in Section VIII.

d) Replicability Issues

Without contest, the most challenging aspect of such anomalies experimentation is the well-known propensity of the phenomena to manifest with only irregular replicability. We have already mentioned the tendency of the desired effects to hide within the underlying random data sub-structures from which they are activated by the participating consciousnesses. But beyond this, one frequently encounters different forms of larger-scale irreproducibilities, wherein entire bodies of empirical data, acquired with equipment, operator pools, protocols, and environmental conditions essentially identical to those of some previous study, return substantially dissimilar, albeit comparably anomalous results. Such disparities also have been observed in the performance of individual prolific operators who on occasion have repeated earlier experiments and produced data streams with anomalous characteristics substantially different than in their original efforts. These capricious "hide-and-seek" characteristics of the effects have provided bountiful fodder for superficial skeptics who gleefully hail them as evidence of incompetent experimentation or delusional data interpretation. More profound contemplation, however, suggests that this apparent irreproducibility may be an intrinsic feature of the phenomena, and a potentially most valuable, if poorly understood, indicator of their fundamental nature. Here we can mention only a few experimental and theoretical attempts to penetrate this mantle of irregular replicability that shrouds establishment of any causal chain that may be functioning in these situations.

Perhaps the most commonly encountered form of this failure to replicate is the ubiquitous "decline effect," wherein initially promising anomalous results, when pursued into second and third generation experiments of identical format, have gradually eroded into insignificance, leading to frustrated abandonment of the study by the investigators, and consequent guffawing by the skeptics. This widespread tendency seemed to us sufficiently crucial to the validity of the topic and its ultimate comprehension to merit a more extensive study than it had traditionally been given, with the ingoing recognition that any systematic pursuit of such a temporal progression of the anomalous effects would necessarily labor under an even more stringent caveat to obtain huge individual and collective datasets if definitive patterns were to be established.

Ref. 16 summarizes the bulk of that exhaustive (and exhausting) study, which in fact has yielded some enlightening results. Namely, the effect sizes achieved by the operators in a broad range of random event generator experiments have shown well-defined patterns of correlation with the ordinal positions of the experimental series in both the collective and individual databases. Specifically, there were statistically significant tendencies for operators to produce better scores in their first series, then to fall off in performance in their second and third, and eventually to recover to some intermediate levels during their fourth, fifth, or subsequent series, eventually stabilizing to a characteristic asymptotic value (*cf.* Figure 12). Such correlations appeared in both local and remote experiments and also were indicated over a sequence of other experimental protocols, but no similar effects were found in baseline or calibration data. In short, there is indeed a decline effect, but it manifests only as an initial phase of a more complex pattern of performance evolution. This pattern bears some

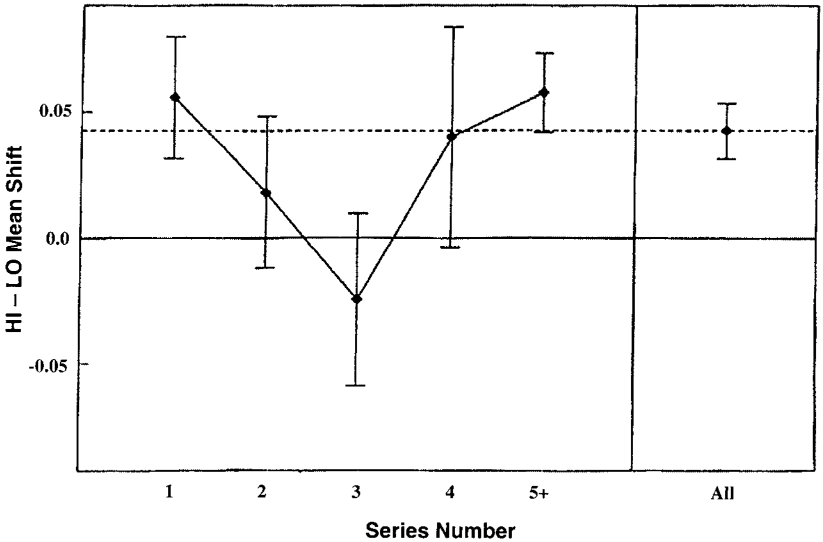

Fig. 12. Composite (HI – LO) REG results for "prolific" operators *vs.* series number.

resemblance to the damped cosinusoidal switching transients that characterize the onsets and interruptions of various forms of mechanical and electromagnetic systems, which eventually converge onto new levels of operation. An extensive survey of more classical psychological literature revealed that similar patterns of effect also can be identified in more conventional experiments on perception, cognition, and memory, suggesting that our anomalous serial position patterns are primarily psychological in origin and may subsume the rudimentary "decline," "primacy," "recency," and "terminal" effects propounded in the parapsychological and psychological literature. Thus once again subjective factors appear as primary correlates in the generation of the objective anomalous effects, and once again the importance of very large individual databases is emphasized.

Empirical demonstration of another genre of reproducibility confounds appeared in the context of a major REG replication study undertaken in collaboration with the Institut für Grenzgebiete der Psychologie und Psychohygiene of Freiburg and the Justus-Liebig-Universität at Giessen University.[17] Using similar equipment and protocols, the three laboratories performed a long and detailed agenda of experiments, the results of which are fully recorded in Ref. 17. To summarize, whereas overall HI – LO mean separations, which were the primary criterion of this replication effort, proceeded in the intended direction at all three laboratories, the size of these deviations failed by an order of magnitude to attain that of our own prior experiments, or even to achieve a persuasive level of statistical significance. However, pre-planned analyses of a number of secondary parameters carried in this study revealed a number of interior structural anomalies unexpected by chance. Utilizing an ingenious Monte Carlo simulation technique that precluded any multiple testing artifacts, our analytical specialist, York Dobyns, was able to demonstrate that this assortment of departures in the individual and collective datasets from the null hypothesis expectations was itself highly significant. It was as if the simple displacements of the mean that had characterized the original benchmark experiments had been partially transformed into a number of more subtle anomalous fragments in the new data. This change from the systematic, intention-correlated mean shifts found in the prior studies to a polyglot pattern of internal distortions of the output distributions underscored our inadequate understanding of the basic phenomena involved and suggested a need for more sophisticated experiments and theoretical models for their further elucidation and comprehension.

On the basis of this new insight, several retrospective analyses of other existing PEAR databases have since been undertaken in a search for similar distortions, and a few additional replication experiments have been initiated to test this transformation hypothesis. While these studies have not yet been completed, it now seems clear that such structural anomalies can on some occasions substitute for, or even supplement, the primary mean-shift effects attempted by the operators. On others, however, the original modes of expression reappear as before. The criteria for such changes are far from established.

In an attempt to tackle the replication issue at an epistemological level, we have collaborated with the theoretical physicist Harald Atmanspacher on a conceptual document entitled "Problems of Reproducibility in Complex Mind-Matter Systems,"(18) which proposes treating mind/matter interactions as generalized complex systems, for which standard first-order approaches are both epistemologically and methodologically inadequate and more sophisticated second-order techniques are required. Only then can the reproducibility problem be properly posed and analyzed, and the inclusion of subjective factors in the dynamical formation of models of these and other consciousness-related phenomena be comprehensively attempted.

e) Pseudorandom Sources

Perhaps our most tantalizing experimental encounter with the replication chimera has been in the use of pseudorandom sources as drivers of the REG equipment. Our earlier query #10 asks a seemingly legitimate, straightforward question of whether some form of physical randomicity is essential to generation of the anomalous effects, or whether deterministic simulation of random source distributions will suffice. The corresponding implications for modeling of the phenomena would be whether to attribute the effects to direct consciousness interactions with the observable physical processes, *per se*, or with the essence of information in a more abstract form, whatever its causal source.

Unfortunately, experimental efforts to resolve this dilemma have led us on a merry chase. Our earliest pseudorandom source employed an array of microelectronic shift registers, overlaid by *ad hoc* appendages to provide operator feedback identical to that presented by the physically random sources. This device yielded initial results very similar to those of the true random sources, but it was later discovered that a technical flaw in the design had allowed a degree of physical randomicity to compromise the otherwise deterministic process. With this corrected, a second database displayed non-significant overall mean shifts, but was dominated by two prolific operator performances, one consistent with intention, the other strongly opposite to intention, leading to some ambiguity in interpretation.

Rather than pursuing this issue further on this equipment, a more substantial experiment was undertaken, utilizing as its source a computer-generated pseudorandom algorithm, whose seed recipe was initiated by the start keystroke of the operator. Statistical analyses of the overall mean shift of this large database indicated no significant anomalous effects. However, when these deterministic-source data were later subjected to retrospective analyses like those outlined in the previous sub-section, striking internal departures from chance behavior became apparent therein, as well. Most notably, although the HI and LO data streams individually fell well within chance expectations, strong and persistent correlations between their sequential behaviors led to significantly depressed variances in the HI – LO differential results, which have always been our primary criteria for anomalous effects. This anomalous correlation persisted even throughout a large "remote" subset of the database, wherein the initiation keystroke was generated by an automated mechanism. This could raise some suspicion about the integrity of the pseudorandom source algorithms, but since no such correlations appeared with the concurrent baseline data, we must look elsewhere for the cause of this aberration in the intentional data.

In an effort to clarify this situation, yet another experimental program, termed PS-REG, was initiated, wherein pseudorandom and physically random sources were randomly interspersed in the trial sequences in a fashion unknown to the operators, with otherwise identical feedback modes. Preliminary inspection of these data has introduced yet another enigma: while some anomalous effects seem to be appearing in the pseudo data, now the comparison data from the physical source have reverted to totally chance behavior!

If the assorted empirical results on the pseudorandom issue are taken at face value, and we have little technical or procedural grounds for dismissing any of them, we need to concede some further daunting complexities in their theoretical implications. It appears that the very attempt to force this empirical distinction between random and deterministic sources has somehow interposed yet another genre of structural aberrations that are seriously confounding the entire evidentiary process. This is not the first example of such empirical obfuscation that we have encountered. It has appeared in several other attempts to derive multi-dimensional correlations from single, complex protocols, such as in the PortREG Replication Study noted earlier,[17] and in a sequence of attempts to establish the dependence of effect size on the rate of bit generation by the electronic source,[19] or on various other secondary parameter options available to the operators. For the present, the pseudorandom issue, *per se*, remains unresolved and, just possibly, may be fundamentally unresolvable within classical scientific criteria. Rather, as Ref. 18 proposes, higher level features, perhaps subjective, perhaps even metaphysical, may be inescapable.

f) FieldREG and the Role of Resonance

We concluded sub-section V-a, with a promise to return to further discussion of subjective correlates introduced by the participation of the human operators in the experimental processes. Beyond the explicit and implicit importance of operator intention (desire, volition, purpose, *etc.*) clearly emerging from the data, and the ubiquitous gender disparities, there is one other such subjective correlate that had repeatedly projected itself anecdotally to equal importance, namely emotional resonance. Akin to the ineffable harmony one can enjoy with a friend or loved one, with an automobile or computer, with a musical instrument or delicate tool, it had been widely testified by our operators that a similar affection or involvement with the experimental devices and tasks could facilitate the desired effects. The superior results achieved by the bonded co-operators also suggest the efficacy of this quality in the experimental environment. We shall therefore conclude this section on salient correlates with a description of an experimental program that most directly addresses the role of such resonance in the anomalous creation of information. We call it "FieldREG."

As mentioned earlier, the microelectronic devices employed in our laboratory-based REG experiments have evolved from rudimentary breadboard circuits, to first-generation boxed units, to much more sophisticated equipment and operational software that incorporates elaborate failsafes, redundancies, and controls to protect its nominal randomicity and guarantees its insensitivity to environmental disturbances and operator mishandling. But with the integrity of large bodies of anomalous data thus assured, the growing availability of superior microelectronic components and circuit designs have facilitated the development and deployment of a sequence of simpler, less expensive, but equally trustworthy units that are sufficiently compact to permit field applications of those readily portable systems. This in turn has enabled a new genre of REG experimentation that has allowed us to address such subjective resonance as a primary variable, much as our laboratory experiments have featured the role of intention. Specifically, the FieldREG studies have explored the correlations of REG outputs with the interpersonal ambiences prevailing in group assemblies engaged in some forms of shared activity that could engender high degrees of emotional resonance among the participants. These have included ceremonies, rituals, therapeutic procedures, artistic performances, sporting events, business brainstorming sessions, and other scenarios that might stimulate collective cohesion among those involved. Collectively, these studies have suggested the generation of a subtle but objectively discernible "consciousness field," to which the FieldREG devices appear to respond with statistically quantifiable anomalous outputs.

In particular, an initial round of pilot experiments,[20] and a more substantial following program of empirical and analytical study,[21] have suggested, and largely confirmed, the hypothesis that data taken in environments featuring strong collective resonance would show larger deviations of the FieldREG output sequences relative to chance expectation than those generated in more pragmatic or mundane assemblies. These studies also have unexpectedly revealed that when immersed in boring, pedestrian, or ego-dominated situations, the FieldREG outputs tend to be suppressed *below* their typical chance expectations. As illustrated in Figures 13a and b, FieldREG units deployed in the "resonant" venues have displayed much noisier displacements of their digital output strings, at a collective χ^2 level of chance probability of 3.2×10^{-10}, while those immersed in the "mundane" environments actually have yielded much quieter traces than expected by chance. While these experiments are still ongoing, we now have in hand a substantial database of several hundred such applications, large enough to assure that the observed results are not attributable to statistical artifact, and that much is to be learned by further systematic research.

The analytical and theoretical complexities posed by these FieldREG studies are quite severe. While the importance of emotional resonance as a second driver of the anomalous effects seems well established, more specific interpretation of the data records in terms of various possible statistical indicators, the direction and endurance of the anomalous excursions, and the specification of the proper null criteria and calibration procedures has yet to be pursued systematically. Beyond that, the development of a database-management system that can effectively index and correlate all of the subjective and objective parameters that might conceivably bear on the form and magnitude of the anomalous responses is a major enterprise in itself, on which we have already expended substantial resources. All of these interpretive challenges notwithstanding, the vision of a technology, however subtle and complex, that could reliably sense the degree of coherent purpose and productive resonance prevailing in such diverse human arenas as business and industry, healthcare, public safety, creative scholarship and education, athletics, and artistic performance, among countless others, and lead to beneficial applications therein, seems to justify extensive effort to bring to fruition.

VI. Intangible Strands

At this point let us again interrupt the technical reportage to weave in a few of the softer interpersonal fibers of the composite PEAR tapestry that in our opinion have not merely embellished, but significantly strengthened it, and very possibly have enabled our continuing progress in constructing this intellectual web. We

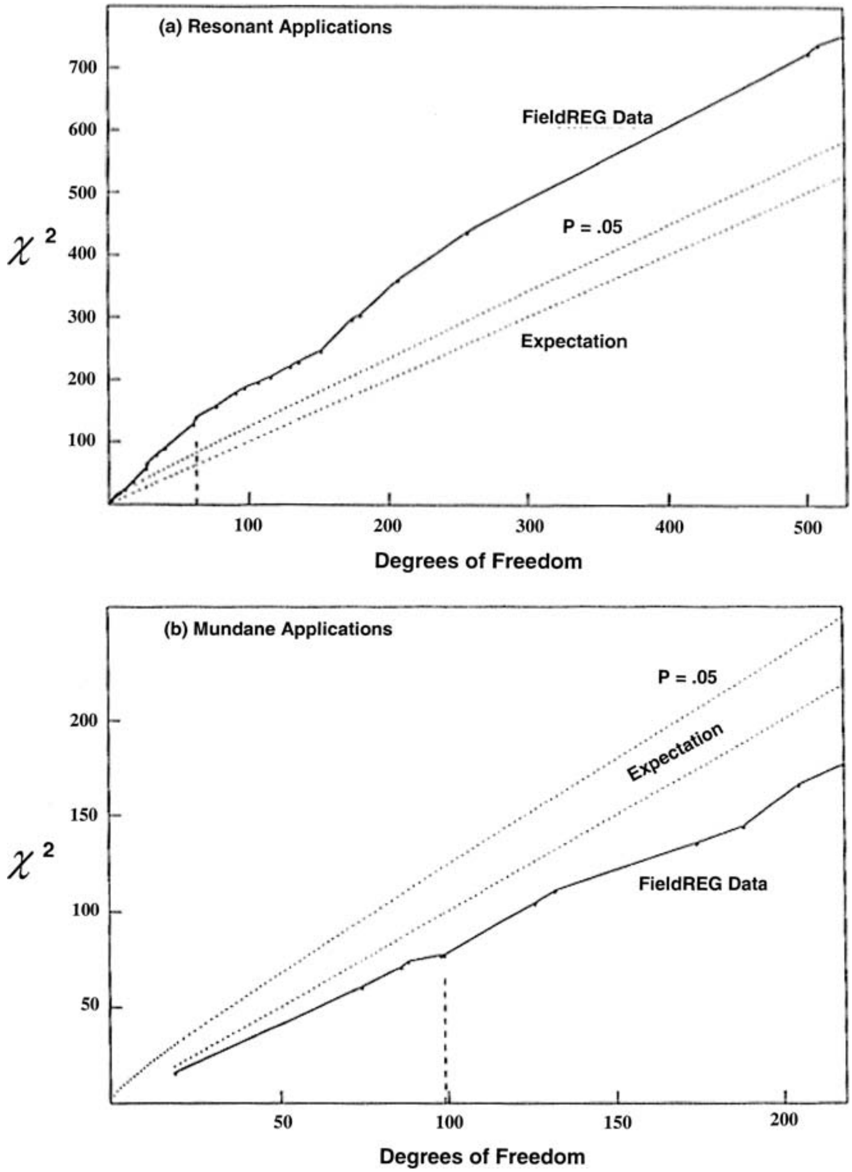

Fig. 13. Cumulative χ^2 values for two categories of FieldREG applications compared to chance expectations: a) "resonant" venues; b) "mundane" venues.

refer here to the cheery, relaxed, even playful ambience that has characterized the laboratory operations from its beginning. Under the intuitive conviction that the anomalous phenomena being sought are somehow nurtured in the childlike, limbic psyche and therefore could well be suppressed or even suffocated by an excessively clinical or sterile research environment, the facility has been decorated with homestyle furniture, symbolic and entertaining visual art, including many cartoons, and an exponentially expanding assortment of stuffed animals, most of which have been gifts from our operators and visitors. Most of the experimental devices themselves embody attractive, stimulating, sometimes whimsical features, not only in their feedback characteristics, but in the operational apparatus, as well. Casual reading material, background music, and light snacks are available for the operators, who are frequently invited to participate in the ongoing technical, philosophical, and social conversations among the staff. In short, the laboratory presents itself more as a scientific salon than as a clinical facility, and many of its operators, interns, and visitors have remarked on the comfort, sense of welcome, and resonance they feel with the place and the work that is being pursued therein. Several have gone so far as to refer to it as a ‘‘refuge’’ or ‘‘sanctuary’’ where they feel free to be their spontaneous and uninhibited ‘‘real selves’’ (*cf.* Figures 14a through d).

The laboratory staff itself has been at least as much characterized by its collective affability as by its technical competence, and this tempering of purposeful intensity with lubricating levity has not only allowed us to survive many difficult professional and political threats, but actually seems to have facilitated the appearance of the phenomena we have been striving to understand. Laboratory parties held on folk occasions such as Halloween, Beltane, the solstices, and equinoxes have complemented the more conventional holiday and birthday gatherings, and despite their superficial jocularities, important conceptual insights quite pertinent to the program have frequently erupted from the spontaneous repartee therein, later to be integrated into our experimental or theoretical projects. Other forms of intellectual stimulation have devolved from our participation in professional society meetings, colloquia, and seminars at our university and elsewhere, and in the course of our advisory roles at various agencies, organizations, and institutions. When formal presentations have been involved, these have been planned collectively, prepared by the particular presenters, and vetted by ‘‘dry-runs’’ before other staff members either at lab meetings or in hotel rooms just before the talks. Ongoing individual and group interactions with other meeting attendees have been helpful in disseminating details of our work and catching up on that of colleagues. From all of this we would return enriched with new ideas and enhanced commitments to our professional and personal purposes.

Consonant with our locus in a distinguished educational institution, major efforts have been expended in various tutorial formats. New visitors are greeted with a cup of tea or coffee and an informal synoptic review of the history, purpose, and accomplishments of the program, followed by a tour of the facilities and an opportunity to try some of the experiments for themselves. The stream of interns mentioned earlier have enjoyed multiple roles of acquiring experiences on experimental, analytical, and theoretical techniques, helping with routine housekeeping functions, and adding their fresh perspectives and light-hearted

Fig. 14. Various segments of the PEAR laboratory: a) Entry and conference area; b) Central nexus and Random Mechanical Cascade apparatus.

(c)

(d)

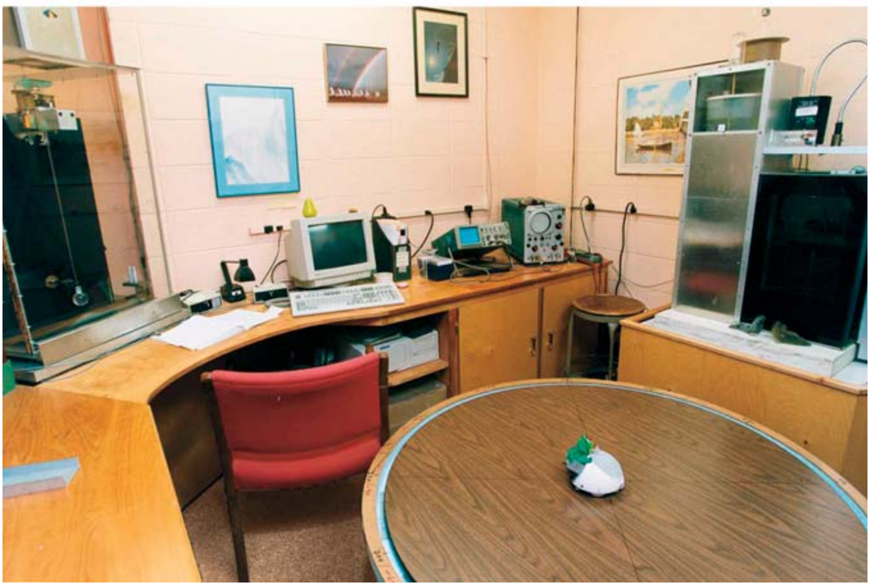

Fig. 14. Various segments of the PEAR laboratory: c) Experimental Room I, with benchmark Random Event Generator and DrumREG equipment; and d) Experimental Room II, with Pendulum, Fountain, and Robot equipment.

personalities to the convivial colloquy of the bustling daily activities. The aforementioned undergraduate “Human/Machine Interactions” course has for many years included a laboratory requirement that each year has immersed scores of students in a brief PEAR experience, and inspired some of them to a more substantial research effort related to this topic. For many years, the Laboratory Manager welcomed groups of fourth-grade students from a local school district who came bearing personal projects they had been pursuing for many weeks in preparation for their visit. Following a brief introductory exchange and participatory tour of our ongoing experiments, each of these youngsters was given a turn to describe his or her own project, its results and conclusions, and the group as a whole would then comment on its concept, implementation, and validity. While it may be difficult to trace the long-term impact of such early exposure to this subject, the teachers of these groups have assured us that the anticipation of the visits, the creative activities they have stimulated, and the enduring recollections of these imaginative and impressionable 10-year-olds have more than justified the efforts expended.

The PEARtree and SSE Young Investigators Programs have required somewhat different tutorial formats, but nonetheless have added their own cultural flavors to the composite PEAR enterprise. Here, much of the intellectual traffic is carried by the participants themselves, interacting electronically and in person at the Academy workshops and Society conferences. Our role has been more one of mentoring, senior guidance, resource provision, and, where necessary, discipline, under the conviction that if these groups are to broaden the reach of the PEAR concepts and to be the source of fresh ideas and enhanced intellectual vigor, and if they are to constitute the seedbed for the next generation of visionary leadership, they must be allowed to develop and demonstrate their talents and commitments under a minimum of authoritarian constraints. Our gratification is that they indeed have displayed this creative capacity, and thereby have enhanced both the substance and tone of the entire mission.

In all of this, it would be misleadingly incomplete not to acknowledge the interpersonal dynamic between the two authors that has prevailed throughout the course of the program. From many months prior to the formal establishment of the PEAR laboratory more than 25 years ago, to this day and hopefully well beyond, the consonance of commitment and purpose that has characterized our efforts as Program Director and Laboratory Manager, respectively, has driven and sustained this unique research vehicle in its tortuous journey over some very rough epistemological, political, and cultural terrain. This is by no means to imply that our insights, tactics, and priorities have always concurred. To the contrary, the major differences in perspective and approach, borne of our widely disparate academic and personal backgrounds, have constituted a vital complementarity of strategic judgment that has triangulated our operational implementation in a particularly productive fashion. It is our intention to develop this aspect of our saga more fully in a future document, but for now we only wish to record it as the essential “warp” supporting the technical “woof” of our PEAR tapestry.

VII. Remote Perception

With the multi-dimensional complexity of our scholarly fabric still in mind, we now turn back to trace the second major experimental enterprise maintained throughout the PEAR program, on the anomalous phenomenon we call ''Remote Perception.'' As the renowned medieval physician and philosopher Paracelsus announced some five centuries ago,

> Man also possesses a power by which he may see his friends and the circumstances by which they are surrounded, although such persons may be a thousand miles away from him at that time,[22]

and this ''power'' has been abundantly demonstrated in various anecdotal forms throughout recorded history. Modern systematic research on the topic was benchmarked by the seminal work of Puthoff & Targ[23] in the mid-1970s, which in turn stimulated a number of programs elsewhere.[24] Our own experimental efforts, which derive from previous studies by one of us (B.D.) at Mundelein College and the University of Chicago,[5,25] comprise some 650 experimental trials that have been summarized in a recent JSE article,[7] and are fully preserved in our data archives. The principal purpose of this portion of our program has been the development of effective analytical judging methods for evaluating the amount of extra-chance information actually acquired by these techniques. Given the comprehensive nature of Ref. 7, we shall here summarize only the main features and their conceptual consequences.

Essentially, the basic protocol of these remote perception experiments involves one participant, termed the ''percipient'' who, without resort to any conventional sensory means, attempts to sense and describe the physical and emotional aspects of a randomly selected geographical site at which a second participant, the ''agent,'' is stationed at a specified time. Both participants are requested to render their descriptions of the scene into free response transcripts, and subsequently into various descriptor specifications that are then compared *via* an assortment of computerized scoring algorithms developed to quantify the degree of information acquisition. The principle findings of this extensive experimental and analytical effort have been both intriguing and bemusing:

1. For the database of 653 formal experimental trials performed over several phases and modalities of the program, the cumulative extra-chance information acquired reaches a statistical Z-score above 5.4 ($p < 3 \times 10^{-8}$).
2. The experimental success is not notably dependent on any of the secondary protocol parameters tested, *e.g.* volitional *vs.* random target selection; percipient/agent familiarity; target categories and characteristics; diurnal or seasonal aspects; *etc.*
3. The information yield shows no statistical dependence on the physical separation of the percipient from the target/agent, up to global distances.
4. Likewise, the results seem statistically independent of the time interval between target visitation by the agent and the perception effort, up to several

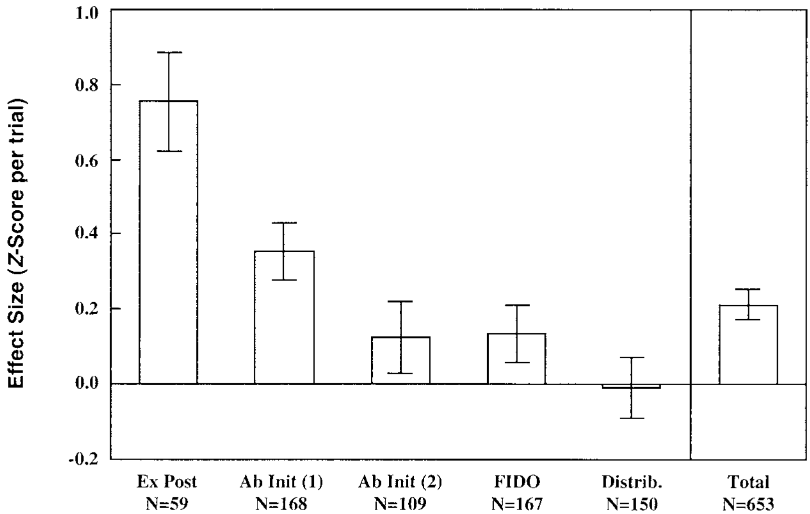

Fig. 15. Decline of remote perception extra-chance information acquisition with increasing analytical scoring complexity. (Scoring method labels defined in Ref. 7.)

days, plus or minus; *i.e.*, precognitive or retrocognitive information acquisition seems comparably effective to that obtained in real time.

5. The amount of information acquisition is strikingly anti-correlated with the degree of complexity of the analytical formats imposed on the percipients and agents in formulating their specifications of the target scenes (*cf.* Figure 15).

As mentioned earlier, the establishment of features (3) and (4) in these experiments inspired remote and off-time studies in the human/machine portion of our program, as well, with similar statistical independence of the effects on intervening distance and time. This in turn strengthened our suspicion that these two superficially different genres of anomalous effect actually were drawing from the same phenomenological well, with the only distinction that in one case information was being inserted into an otherwise random physical process; in the other, information was being extracted.

Observation (5) actually may have even more profound implications for conceptualization and representation of these phenomena, in the sense that here we seem to be encountering manifestation of an inescapable "consciousness uncertainty principle" that may inherently constrain our ability to achieve such effects. This issue has been pursued in some detail in Ref. 7, and from somewhat different perspectives in Refs. 1, 9, 26, and 27. The generic concept emerging from these empirical and theoretical considerations is that while the emergence of consciousness-related anomalous physical effects seems largely to be driven by a host of subjective factors, our efforts to demonstrate, record, and quantify them necessarily entail the imposition of objective criteria and measurements. Unfortunately, the former appears to be obstructed by the latter, and vice versa, and we are left with the challenge of finding a way to straddle the subjective/objective dichotomy with some optimized compromise. As Heisenberg himself conceded in his own extrapolation of the atomic scale uncertainty/complementarity principle:

> We realize that the situation of complementarity is not confined to the atomic world alone; we meet it when we reflect about a decision and the motives for our decision or when we have the choice between enjoying music and analyzing its structure.[28]

In similar sense, our efforts to establish defensible and quantitative remote perception data by successive refinements of the analytical techniques appear to have progressively suffocated emergence of the phenomenon itself. Whether this interference functions primarily in the psyches of the human participants, or whether it is more endemic in the physical character of the information itself, is unclear and possibly unresolvable. Notwithstanding, similar indications have emerged from a number of our other experiments, collectively suggesting that this uncertainty is not merely a limitation on the attainable empirical precision, but is evidence of the fundamental importance of informational ‘‘noise’’ as a raw material out of which the anomalous effects are constructed. Ref. 7 cites comparable examples from less controversial physical, technological, biological, and psychological venues wherein stochasticity also seems to play essential roles in the establishment of orderly effects. In our context, such a counter-intuitive noise/signal dynamic, compounded with the other extraordinary characteristics of the phenomena, further challenges attempts to construct defensible and viable models, a task to which we now turn.

VIII. Theoretical Models

From the outset, the PEAR program has recognized and been committed to the primary principle of all productive scientific research that rigorous empirical results must enjoy a dialogue with astute theoretical models if consequential scholarly understanding is to advance. As Sir Francis Bacon so charmingly enjoined in his definition of the scientific method some four and a half centuries ago:

> . . . Those who have treated the sciences were either empirics or rationalists. The empirics, like ants, only lay up stores, and use them; the rationalists, like spiders, spin webs out of themselves; but the bee takes a middle course, gathering her matter from the flowers of the field and garden, and digesting and preparing it by her native powers. In like manner, that is the true office and work of philosophy, which, not trusting too much to the faculties of the mind, does not lay up the matter, afforded by natural history and mechanical experience, entire or unfashioned in the memory, but treasures it, after being first elaborated and digested in the understanding; and, therefore, we have a good ground of hope, from the close and strict union of the experimental and rational faculty, which have not hitherto been united.[29]

In Ref. 1 we presented in some detail our own form of ‘‘Scientific Two-Step,’’ which we knew had to be respected, especially in the pursuit of initially inexplicable physical anomalies, if a solid platform of knowledge was to be built. The problem we face, however, is that the empirical studies, even when very carefully performed, present such a bewildering array of irregularities, contradictions, and departures from canonical, indeed from rational and even intuitive, precedents and expectations that any classical modeling strategies are essentially denuded of any hope of effectiveness. Simply reprising our foregoing text, we encounter a daunting array of phenomenological characteristics that any proposed model is obliged to accommodate, *e.g.*:

- Tiny informational increments riding on stochastic statistical backgrounds;
- Primary correlations of objective physical evidence with subjective, psychological parameters, most notably "intention" and "resonance";
- Statistical independence of the magnitude of the effects on intervening distance and time;
- Oscillatory sequential patterns of performance;
- Data distribution structures consistent with slight alterations in the prevailing elemental probabilities;
- Functional importance of uncertainty in the information transfer processes;
- Complexly irregular replicability.

These inescapable empirical characteristics force abandonment of any direct applications or extrapolations of extant physical, psychological, or informational models, and of necessity turn us toward more radical propositions, whereby consciousness can assume a proactive role in the establishment of physical reality, and deterministic causation is vastly generalized.

The overarching character of such unconventional modeling approaches is proposed in the article "Science of the Subjective,"[30] which specifies the challenge in the following terms.

> Any disciplined re-admission of subjective elements into rigorous scientific methodology will hinge on the precision with which they can be defined, measured, and represented, and on the resilience of established scientific techniques to their inclusion. For example, any neo-subjective science, while retaining the logical rigor, empirical/theoretical dialogue, and cultural purpose of its rigidly objective predecessor, would have the following requirements: acknowledgment of a proactive role for human consciousness; more explicit and profound use of interdisciplinary metaphors; more generous interpretations of measurability, replicability, and resonance; a reduction of ontological aspirations; and an overarching teleological causality. More importantly, the subjective and objective aspects of this holistic science would have to stand in mutually respectful and constructive complementarity to one another if the composite discipline were to fulfill itself and its role in society.

Within this generic attitude, our particular efforts have converged on three conceptual frameworks, each of which has been thoroughly described in a number of publications and presentations. Here we can only sketch the essence of each very briefly.

a) Quantum Mechanics of Consciousness

Quite early in the program we were struck by a number of similarities between the historical and philosophical evolution of quantum science and the ongoing unfolding of the experience and representation of consciousness-related physical anomalies. In both scenarios, classically respected conceptual and analytical models of reality have been challenged by the advent of diverse bodies of new empirical data, made possible *via* the development of more sensitive and reliable experimental equipment. In each case, extensive attempts to rationalize the anomalous data within prevailing formalisms have proven categorically and profoundly unsuccessful, forcing postulation and development of a number of counter-intuitive concepts. Some of those that were originally posed in the atomic-scale physical domain seem to offer potentially productive metaphorical associations with the mind/matter issue, as well. Among these one could list the quantization of energy and other physical observables; the wave/particle duality and the wave mechanics of atomic structure; the uncertainty, complementarity, exclusion, and indistinguishability principles; and the probabilistic character of quantum observations. The radical new proposition underlying this appropriation is that all of these might be regarded as impositions by the experiencing consciousness, rather than as intrinsic characteristics of the physical events, *per se*.

The model proposed in Ref. 9 takes the position that reality is constituted only in the interaction of consciousness with its environment, and therefore that any scheme of conceptual organization developed to represent that reality must reflect the processes of consciousness as well as those of its environment. In this spirit, the concepts and formalisms of elementary quantum mechanics are appropriated *via* suitable metaphors to represent the characteristics of consciousness interacting with its environment. More specifically, we propose that if a consciousness is represented by a quantum mechanical wave function, and its environment, including its own physical corpus, is represented by an appropriate potential profile, Schrödinger wave mechanics yields eigenfunctions and eigenvalues that can be associated with the cognitive and emotional experiences of that consciousness in that environment.

To articulate this metaphor it is necessary to associate certain quantitative aspects of the formalism, such as the coordinate system, the quantum numbers, and even the metric itself, with various qualitative descriptors of consciousness, such as its intensity, perspective, approach/avoidance attitude, balance between cognitive and emotional activity, and ‘‘yin/yang’’ or receptive/active disposition. With these in hand, certain computational applications can display metaphoric relevance to individual and collective experience, and in particular to our experimental situations. Specifically, such traditional quantum theoretic exercises as the central force field and atomic structure, covalent molecular bonds, barrier penetration, and quantum statistical collective behavior can become useful analogies for representation and correlation of a variety of consciousness experiences, both normal and anomalous, and for the design and interpretation of experiments to study these systematically. For example, many ''anomalous'' consciousness capabilities would follow normally from its ''wave/particle'' duality; our empirical resonance factor can be related to molecular bonding; our gender and co-operator effects to electronic spin and its pairing; FieldREG effects to collective particle behavior in various potential wells; and the conditional replicability features to the intrinsic statistical uncertainties of all quantum phenomena.

Although requests for reprints of this paper have numbered in the hundreds, it also has elicited complaints from some members of the traditional theoretical physics community who have perceived it as a prostitution of their more narrowly defined quantum formalisms. Notwithstanding, it has proven quite serviceable as a conceptual representation of mind/matter interactions wherein the ''anomalous'' effects become quite normal expectations of quantum-bonded human/machine and human/human systems.

b) Modular Models

A second model, also amenable to cross-disciplinary application, has been articulated in a paper entitled ''A Modular Model of Mind/Matter Manifestations (M^5),''[31] and extended in a subsequent article called ''M*: Vector Representation of the Subliminal Seed Regime of M^5.''[32] In brief, the M^5 and M* models postulate that anomalous effects such as those observed in our experiments do not emerge from direct intercourse between the conscious mind and the tangible physical world, but have their origins in the depths of the unconscious mind and an intangible substrate of physical reality, wherein the Cartesian distinction between mind and matter blur and lose their functional utility. This is a misty domain of uncertainty and probability, where space and time have yet to be defined, let alone distinguished, and where information waits to be born. Our representation proposes that when the conscious mind expresses a strong desire, enhanced by deep feelings of resonance, that resonant intention stimulates some process in the unconscious mind that is reflected in the pre-physical potentiality, and subsequently expressed *via* a subtle biasing of probabilistic physical events. This process also may work in reverse order, as in the remote perception experience, where physical information about the target scene diffuses into its underlying intangible composition, whence it may interact with, and exert some formative influence upon, the unconscious mind of the percipient, thence to emerge into a conscious experience and subsequent description of the scene. With the bounded modules of the conscious mind and manifest physical world thus indirectly linked *via* the unbounded modules of the unconscious and the intangible substrates, it should not be surprising to encounter apparently acausal correlations that we classify as ''anomalies'' (*cf.* Figure 16). This model also raises, but does not attempt to resolve the possible role of, a much vaster cosmic ''Source,'' which may permeate, influence and inform the entire modular configuration.

The implications of this taxonomy for experimental design and interpretation

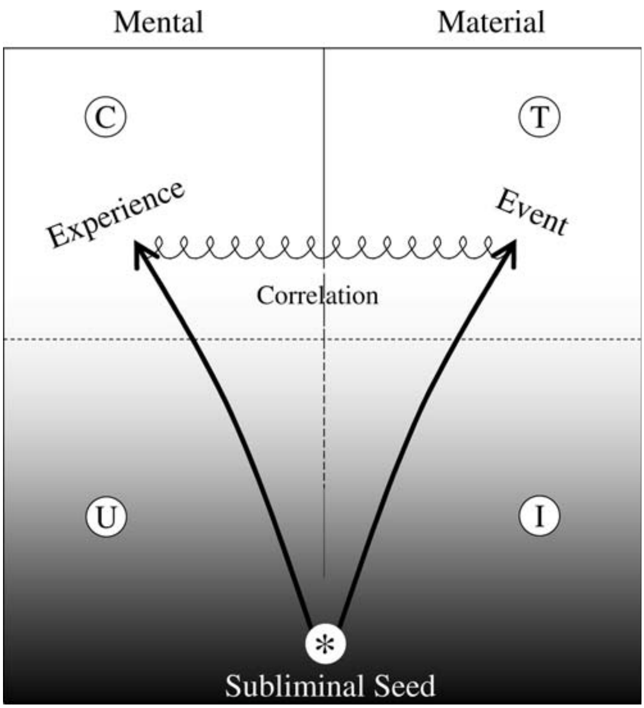

Fig. 16. M^5 taxonomy for anomalous correlations of material events and mental experiences.

include subtler feedback schemes that facilitate submission of conscious intention to unconscious mental processing; physical target systems that provide a richness of intangible potentialities; operators who are amenable to such a mechanism; and an environmental ambience that supports the composite strategy. Requisites for theoretical extension of the model include better understanding of the information dialogue between the conscious and unconscious aspects of mind; more pragmatic formulations of the relations between tangible and intangible physical processes; and, most importantly, cogent representation of the merging of mental and material dimensions into indistinguishability at their deepest levels.

One possible format for visualization of the subliminal seed space that undergirds the tangible reality and conscious experience regimes utilizes an array of complex vectors whose components embody the pre-objective and pre-subjective aspects of their interactions.(32) Elementary algebraic arguments then predict that the degree of anomalous correlation between the emergent conscious experiences and the corresponding tangible events depends only on the alignment of these interacting vectors, *i.e.*, on the correspondence of the ratios of their individual ‘‘hard’’ and ‘‘soft’’ coordinates. This in turn suggests a subconscious alignment strategy based on strong desire, shared purpose, and meaningful resonance that is consistent with our empirical experience. Several of our most recent ongoing experiments have been specifically designed to test these and other aspects of the predictions, but have not yet produced large enough databases to permit definitive conclusions.

c) Consciousness Filters

The concept of an ongoing two-way exchange between a primordial Source and an organizing Consciousness, posed briefly in the M^5 context, has been developed more thoroughly in a more recent theoretical endeavor, entitled ''Sensors, Filters, and the Source of Reality.''(27) This model proposes that the limited local interactions of individual consciousness with its proximate environment are merely microcosms of a vaster creative process in which we are capable of participating, whereby we may acquire more profound information and alter our personal experience to an extent dependent on the depth and breadth of the interpenetration of the consciousness and its Source. Small as the individual effects may be, collectively they can compound to significant influence on the Source itself. Such interactions are both facilitated and inhibited by the intervention of an array of physiological, psychological, linguistic, and cultural influences, or ''filters,'' which condition our perceptions and thereby our conscious experiences, and thus limit our direct access to the Source. Since most of these filters function on an unconscious level, however, we seldom invoke interpretations of our experiences other than those consistent with our filtered preconceptions. By bringing these influences to a conscious level, it becomes possible to re-tune the filters of consciousness and thus to alter our experiential reality to a measurable degree, thus substantiating Niels Bohr's profound conviction that ''we are both onlookers and actors in the great drama of existence.''(33) More specifically, it is proposed that such attitudinal tactics as openness to alternative perspectives, utilization of associative metaphors, transpersonal resonance, tolerance of uncertainty, and balance of analytical rigor with emotional investment, can enable experiential realities that are responsive to intention, desire, or need, to an extent consistent with prevailing empirical evidence. This conceptual model shares some features with a host of spiritual and metaphysical traditions, and with a growing attention of certain theoretical physicists to the distinction between ''epistemic'' and ''ontic'' levels of reality, or, in alternative parlance, between ''exophysical'' and ''endophysical'' models thereof.(34)

IX. Responses

Each of the pragmatic queries posed near the beginning of Section III, has now been addressed *via* the pertinent experimental data and related conceptual models presented above and in the corresponding referenced literature. On the basis of this empirical and analytical experience, we may now also respond with some confidence to the overarching strategic challenges defined at the genesis of the program (Section II), *i.e.*:

1. *Are such mind/matter anomalies legitimate?*
   Yes, by any reasonable scientific standard. The composite formal human/machine results are unlikely by chance to the order of 10^{-12}; the formal PRP results to the order of 10^{-8}.
2. *Are they amenable to systematic scientific investigation*?
   Yes, although their dependence on subjective factors and their irregular statistical replicability pose non-traditional problems of demonstration and interpretation. Specifically, the experimental and analytical strategies and the theoretical formulations must accept the primary importance of subjective features in the stimulation of these phenomena, with their consequent irregular replicability.
3. *What is their scale?*
   Signal-to-noise ratios of the order of 10^{-4} are typical.
4. *Do they display characteristic structural features?*
   Yes. In addition to statistically anomalous distribution mean shifts, we have identified a variety of goodness-of-fit (χ^2) aberrations and other operator-specific asymmetries and irregularities in the data distributions.
5. *What are their primary physical correlates?*
   None are readily apparent, other than that the effects seem to derive from random sources and processes rather than from constrained deterministic events, with intrinsic uncertainty playing an important role in their manifestation.
6. *What are their primary subjective correlates?*
   While we have not performed explicit psychological or neurophysiological measurements, it is clear from our physical experiments that intention (volition, desire, *etc*.); subjective resonance with the device, process, or other individuals in the environment; unconscious involvements; and operator gender can have substantial influence on the results.
7. *What is their empirical replicability?*
   Irregular, at best, but statistically robust over large databases.
8. *Can theoretical models be constructed?*
   At the conceptual level, yes, but effective canonical formalisms are yet to be developed, and probably must await more definitive empirical correlations.
9. *What are their scholarly interfaces with other technical disciplines?*
   Physical, chemical, and biological sciences; psychology; information technology; health care; or indeed any field that entails human observation or interaction with non-deterministic processes.
10. *Are they related to other domains of creativity or aesthetics?*
    Virtually every domain of human creativity, aesthetic appreciation, or spirituality.
11. *What are the implications for scientific methodology?*

Uncertainty, subjectivity, and a proactive role of consciousness need to be explicitly accommodated.

12. *What pragmatic applications can be foreseen?*
    Short-term: technological detection of, response to, and utilization of, subtle human information processing capabilities.
    Longer-term: release of suppressed subjective sensitivities and their greater utilization in creative and pragmatic contexts.
13. *What are the broader cultural implications?*
    Enhancement of human self-image, personal responsibility, relationships with others, stewardship and enjoyment of the environment, and evolutionary drive.

Virtually every item on this cryptic list could be pursued in a substantial philosophical monograph, none of which can be undertaken here, and each could inspire much more detailed empirical study and theoretical modeling than we have been able to complete. Given the technical, professional, and personal challenges such commitments would require, it is inappropriate for us to exhort others to don this mantle. Rather, we might only suggest to those readers contemplating such involvement that the price of entry into this epistemological wonderland includes the capacity for humility, humor, and profound personal commitment. For ourselves, we can only confess overwhelming satisfaction at having made that investment at a corresponding juncture in our own careers, and a sense of privilege and gratitude for the opportunity we have enjoyed to participate in and contribute to this exciting and challenging domain. The respect for these capricious phenomena, the intellectual and emotional stimulations they have provided, and the resonant interactions with other players that they have engendered have far exceeded those we have derived from any other professional and personal activities, and we suspect that they have prepared us well for whatever future professional and personal challenges we may meet in this life, or beyond. Nonetheless, others must buy their own tickets, make their own selections of activities, and form their own conclusions.

X. Going Forward

As the authors approach retirement from their university positions, with the inevitable dissolution of the Princeton laboratory complex that will accompany that transition, it is imperative that plans be made for some following phase of a more extended and enduring PEAR-related enterprise, and that a viable and productive agenda be pursued in the time remaining that will gracefully bridge the two eras. With respect to the former, no firm plans have yet been made, although several options are being considered. Insofar as the laboratory transition agenda is concerned, however, the aspirations are more clearly established and well under way. These focus on three primary goals:

a) Archiving

As described throughout this paper, over our 26-year history we have designed and constructed a broad variety of experimental facilities of considerable capital value; accumulated many immense databases that continue to serve as empirical reservoirs for future analyses and the development of theoretical models, the conception of new experiments, and the enhancement of intellectual insights in our own laboratory and elsewhere; written hundreds of archival publications, detailed technical reports, and a book that has become a definitive reference in this field; presented numerous invited talks to appropriate professional societies; and developed an undergraduate course with an associated laboratory experience, and an internship program to attract and enable young scholars from elsewhere who are interested in this topic. At this time, it seems prudent, indeed morally obligatory, to undertake a comprehensive archiving effort that will ensure preservation and availability of the laboratory data, publications, equipment, and overall intellectual insights accumulated over the past two and a half decades. The primary purpose of this project is to provide an organized and centralized body of resources as a foundation on which future scholars may efficiently base their own architectures of understanding. A secondary goal is to enhance the growing public awareness of the scientific validity of research such as ours, and its potential practical applications. Specific elements of this broad effort include the deployment of the experimental equipment to new locations where it can continue to serve scholars pursuing this form of research; completion, organization, and placement of all relevant technical and philosophical written documents into user-friendly formats that will be readily accessible to future investigators; and preparation of a variety of other forms of documentation addressed to both specialist and public audiences. Major portions of this project have been underwritten by grants from several individual and institutional philanthropists, although a fully comprehensive effort will still require additional support.

b) Outreach

The programs of educational outreach and stimulation embodied in the ICRL/PEARtree activities, the SSE Young Investigators Program, and the laboratory intern formats described in Section VI, clearly must transcend the conclusion of the PEAR laboratory's technical operations and continue to expand into more extended configurations. The conviction here is that it is from the young people of the world, not yet intellectually and emotionally constrained by the entrenched pedagogy and values of the canonical establishments, that the most creative new ideas, and the vigor and courage to pursue them, will emerge. We see our continuing role to be the encouragement, protection, and support of them until they can fly on their own.

c) Applications

As some wag once remarked, "If we had waited until we understood combustion before we built automobiles, we would all still be riding horses." The truthful essence of that maxim is that nothing stimulates public attention to a topic better than its demonstrable practical applications, whether or not we may fully understand it fundamentally. The same applies to the study of consciousness-related anomalies, especially since their fundamental comprehension may evade us for some time. Nothing would inspire greater scholarly interest, silence the skeptics, and generate major financial support for further research better than empirical demonstration of the profitable pragmatic utilization of these currently inexplicable effects. And we are not far from that demonstration. As mentioned earlier, our FieldREG results suggest that we are at the edge of a microelectronic technology that in its capacity to detect collective harmonies of purpose has foreseeable beneficial applications in a variety of public and private enterprises. A more proactive vision entails implementation of synergistic influence of human intention on suitably configured electronic processors to achieve capabilities beyond those of the devices themselves. Thus, the third major segment of our transition agenda entails continuation and completion of a group of basic experiments and theoretical models that appear to hold particular promise for eventual transfer of our understanding and laboratory technology into practical deployment in various sectors of engineering, health care, business, education, entertainment, and public safety.

XI. Epilogue

This article began with a warning that its substance and style would depart considerably from those of a standard scientific review, and indeed the preceding pages have broached several non-technical dimensions that rarely intrude upon conventional scientific research, let alone on its reportage. Our concluding comment here is simply to emphasize that this has not been mere editorial whimsy. Rather, it has been an attempt to convey the hard-won conviction that significant progress in capturing and comprehending these elusive effects requires the investigators to handle with equanimity and skill all manner of subjective and interpersonal ramifications and intrusions and, where feasible, to entwine them productively with the more traditional research fibers. This is not only a defensive strategy to sustain the stability of the program against external pressures. It is the essence of the phenomena themselves that they can erupt spontaneously and sporadically in any experiential venue, technical or other, and it is from collective study of these complex composite patterns of manifestation that we have the best hope for their definition and comprehension. Monotonic attempts to display and confine these phantoms of physical effect, however promising the venue may seem initially, eventually run dry, while the effects find other formats to express their intrinsic irregularity. Standard replicability criteria and deterministic mechanics are thereby taunted, and a more sophisticated conception of causality must be sought, such as has been advocated and illustrated above. This capriciousness has been found, in an almost fractal-like sense, at all levels of our research operations. At the most rudimentary scale of the REG effects, the experimenter is totally impotent to identify which particular bits in the information stream have been altered from their random expectation; the anomalous effects manifest statistically only on the stream as a whole. Even the mean shifts thus defined variegate from trial to trial, from series to series, from day to day, from operator to operator, in a manner that suggests inextricable dependence on the subjective environment in which the experiments are performed. Worse yet, the initial modes of anomalous expression may subside after a time, temporarily or permanently, to be replaced by a variety of structural distortions at other levels of the corresponding data distributions, much as a laminar fluid stream may unpredictably dissipate its orderly motion into patterns of turbulence, and recover therefrom.

And this complexity of expression is not restricted to the experimental results. On many occasions we have encountered inexplicable aberrations in the ancillary fibers of our enterprise as well: improvements or deteriorations in the staff interpersonal dynamics; environmental benefits or hindrances to our laboratory functions; totally unexpected financial contributions, or abrupt cessations thereof; unsolicited professional endorsements or skeptical interference; sudden appearance of dedicated volunteers, or of disruptive critical challengers; spontaneous public acclamations, or malicious discredits; periods of blazing insight, or doldrums of confusion and confound. None of these have been particularly remarkable events individually, but collectively they have compounded to a cacophony of sporadic stimulation and suppression that has far exceeded any reasonable expectations. It is almost as if the program has established a felicitous home for the phenomena to reside, wherein they can express themselves in many ways, at many levels of experience, for observation by those seeking their understanding.

The celebrated movie "Field of Dreams" begins with a mid-Western farmer being exhorted by a disembodied voice proclaiming "If you build it, they will come." The "it" refers to a rudimentary baseball facility he is to carve out of his cornfield. "They" refers to an ensemble of spiritualized baseball players of the past, and somewhat later to an audience of live spectators that will assemble to watch them play. The ensuing drama involves a supporting cast of characters bringing an array of familiar attributes and reactions to this implacable enterprise: a long-suffering but tolerant wife; an ingenuously supportive child; an estranged, departed father; indignant and derisive neighbors; recalcitrant financiers; and an endearing sports fan who in his own terms has heard the same call, resisted it for a while, and finally submits to a cooperative enterprise. So despite the raucous opposition the facility is built, complete with night lighting, spectator stands, dugouts, and other accoutrements, and the spiritual players do indeed appear to play their magical games. Old personal relationships are healed, other issues of the past are resolved, other miracles occur, and the world swarms to the site to see for itself the transcendent scene.

Of course we claim none of the majesty of this extravaganza, but we cannot escape a similar sense that having responded to our own form of summons to construct the PEAR laboratory, with all of the conglomerate physical, technical, environmental, social, and spiritual characteristics it has embodied, it too has somehow become a sanctuary for the spirit as well as the substance of the phenomena under study, and for the growing community of seekers from all around the world who also have been called to explore them. It is our hope that when this laboratory, like Brigadoon, dissolves back into the mist of the more conventional academic countryside, that sublime spirit, along with the more tangible accomplishments, will also survive to inspire, sustain, and delight those who believe enough in the power of love to seek its manifestation in the future.

This, in essence, is the PEAR Proposition.

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