Journal of Scientific Exploration

A Publication of the

SOCIETY
FOR
SCIENTIFIC
EXPLORATION

VOLUME 35
ISSUE 2
Summer 2021

JOURNAL OF SCIENTIFIC EXPLORATION
A Publication of the Society for Scientific Exploration

(ISSN 0892-3310) published quarterly, and continuously since 1987

Editorial Office: Journal@ScientificExploration.org

Manuscript Submission: http://journalofscientificexploration.org/index.php/jse/

SUBSCRIPTIONS & PREVIOUS JOURNAL ISSUES: Order at scientificexploration.org

Society for Scientific Exploration—https://www.scientificexploration.org

Journal of Scientific Exploration (ISSN 0892-3310), an open access, peer-reviewed journal, is published quarterly in March, June, September, and December by the Society for Scientific Exploration, PO BOX 8012, Princeton, NJ 08543 USA. The Journal is free to everyone. Print subscriptions: Society members: $60 per year, Libraries: $165 per year.

JOURNAL OF SCIENTIFIC EXPLORATION
A Publication of the Society for Scientific Exploration

AIMS AND SCOPE: The *Journal of Scientific Exploration* is an Open Access journal, which publishes material consistent with the Society's mission: to provide a professional forum for critical discussion of topics that are for various reasons ignored or studied inadequately within mainstream science, and to promote improved understanding of social and intellectual factors that limit the scope of scientific inquiry. Topics of interest cover a wide spectrum, ranging from apparent anomalies in well-established disciplines to rogue phenomena that seem to belong to no established discipline, as well as philosophical issues about the connections among disciplines. The *Journal* publishes research articles, review articles, essays, commentaries, guest editorials, historical perspectives, obituaries, book reviews, and letters or commentaries pertaining to previously published material.

The Journal of Scientific Exploration is indexed in Scopus, Elsevier Abstracts, CrossRef, and the Directory of Open Access Journals (DOAJ).

https://doi.org/10.31275/20212193 for this whole issue PDF, *JSE*, *35*(2), Spring 2021.

JOURNAL OF SCIENTIFIC EXPLORATION
A Publication of the Society for Scientific Exploration

Volume 35, Number 2 2021

EDITORIAL

261 **The Need for Negativity** Stephen E. Braude

RESEARCH ARTICLES

267 **EEG Activity During Mental Influence on a Random Signal Generator** William Giroldini, Luciano Pederzoli

287 **Mind–Matter Entanglement Correlations: Blind Analysis of a New Correlation Matrix Experiment** Hartmut Grote

311 **The Effects of Meditation and Visualization on the Direct Mental Influence of Random Event Generators** Tayzia Collesso, Maria Forrester, Imants Barušs

345 **Phenomenological Interpretations of Some Somatic Temporal and Spatial Patterns of Biophoton Emission in Humans** Daqing Piao

COMMENTARY

383 **Reply to: Grote, H. (2018). Commentary: Intentional observer effects on quantum randomness: A Bayesian analysis reveals evidence against micro-psychokinesis** Markus A. Maier, Moritz C. Dechamps, Günter Schiepek

BOOK REVIEWS

389 Historical Views of Spiritism and Mediumship in Spain, 1880–1930 *Ciencia y Espiritismo en España, 1880–1930* [Science and Spiritism in Spain, 1880–1930] by Andrea Graus Carlos S. Alvarado

405 Has Physics Theory Become Vacuous?
Lost in Math: How Beauty Leads Physics Astray by Sabine Hossenfelder — Henry H. Bauer

415 *Sensitive Soul: The Unseen Role of Emotion in Extraordinary States* by Michael A. Jawer — Robert S. Bobrow

417 *An Extraordinary Journey: The Memoirs of a Physical Medium* by Stewart Alexander — Zofia Weaver

422 *Science Fictions: How Fraud, Bias, Negligence, and Hype Undermine the Search for Truth* by Stuart Ritchie — Henry H. Bauer

433 *Mystery Cats of the World Revisited: Blue Tigers, King Cheetahs, Black Cougars, Spotted Lions, and More* by Karl P. N. Shuker — George M. Eberhart

SSE NEWS

444 Aspiring Explorers News
445 SSE Masthead
446 Bial Foundation Awards Available
448 Index of Previous Articles in *JSE*
470 Gift Orders, Gift Memberships, Back Issues, Society Membership
472 Instructions for *JSE* Authors

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 261–266, 2021 0892-3310/21

EDITORIAL

The Need for Negativity

Stephen E. Braude

https://doi.org/10.31275/20212191

Several of my recent Editorials have dealt with terminological/conceptual errors and confusions that have been all too prevalent among psi researchers. In this Editorial, I want to consider a related issue often raised about parapsychological concepts and explanation.

Probably we've all heard the complaint that parapsychology's core concepts have been defined only negatively, with respect to our present level of ignorance—for example, taking "telepathy" to be "the causal influence of one mind on another independently of the *known* senses." Perhaps some of you have even expressed that complaint yourselves. Of course, the assumption underlying those complaints is that this definitional strategy is a problem. However, it seems like a perfectly reasonable procedure to me, and I can easily accept the possibility that we might eventually learn enough about phenomena so defined that we can later construct better, detailed, and more informative analytical definitions.

But at least as far as psi research is concerned, I consider it presumptuous—at our present (and considerable) level of ignorance—to proceed any other way. We hardly have the barest hint, based on all the available data, as to what psi is doing in the world (i.e., both inside and outside the lab). In fact, formal, experimental evidence has been particularly unilluminating. It has barely succeeded, if it's succeeded at all, in convincing parapsychological fence-sitters that there are any genuine paranormal phenomena to study (I've explored some reasons for this in Braude, 1997). And it certainly hasn't shed light on how pervasive, extensive, and refined psi effects might be, or whether effects

of radically different magnitudes would be the result of substantially different processes. At best, typical quantitative research examines only straitjacketed expressions of phenomena that non-laboratory evidence suggests occur more impressively (if not flamboyantly) "in the wild." So it strikes me as appropriately modest and circumspect to define "PK" (for example) as "the effect of an organism on a region *r* of the physical world without any known sort of physical interaction between the organism's body and *r*." (For additional specific parapsychological definitions, see Braude, 2002).

Philosopher Michael Scriven addressed this topic very sensibly back in the 1970s (Scriven, 1976). Among other things, and focusing more specifically on the topic of scientific explanation, he argued (plausibly) that so-called negative definitions are still substantive. Scriven wrote,

> . . . let us briefly consider another of the puzzles about explanation and ESP. Richard Robinson once complained that parapsychologists thought they were explaining something by labelling it "telepathy," whereas, he said, labelling something "telepathy" is simply to say that it cannot be explained. Here's another example of an attempt to dispose of the supernatural or the parapsychological by a piece of logical legerdemain. Again, it will illustrate the extent to which a better understanding of the theory of explanation can enable one to cope with apparent conceptual difficulties in this area. Contrary to Robinson's view, it is—in certain contexts—perfectly appropriate for somebody to offer as an explanation of a puzzling phenomenon the hypothesis that it is due to telepathy; by this he or she means to convey the fact that transfer of information is occurring other than by the typical means, and the existence of this information in the mind of some individual associated with the experimenter is a necessary condition for success. There is plenty of meat in this hypothesis—meat that can be tested. For example, it denies that ordinary sensory transfer is occurring, and it denies that clairvoyance would be an adequate explanation of the events. On the other hand, of course, it does not provide a theory of telepathy itself. To explain a remarkable performance by a stage mentalist, by saying that he memorizes a list of key words, may be perfectly legitimate, even though one cannot give an explanation of the phenomenon of memory. Explanations all come to an end; explanations all leave other things unexplained. Explanations [in terms of] telepathy are perfectly legitimate, even though telepathy is not explained. (Scriven, 1976, p. 193)

It might help here[1] to remember that science started with, and has always been driven by, the desire to explain what we've already and undeniably observed to occur. In fact, it's easy to rattle off long lists of phenomena we've both named and ascertained to be genuine before we had—or before we at least settled on—a theory as to why or how they occurred. Consider, for example, lightning, thunder, heat, rain, earthquakes, sunrise and sunset, lunar cycles, tides, magnetism, organic growth and development, aging, tooth decay, inherited characteristics, memory, pain, the surprising and anomalous skills of savants, and hair loss (some of these we still don't know how to explain).

Of course, our interpretations of these phenomena have occasionally changed in the process of trying to make sense of them. And so sometimes our explanatory efforts lead to a change both in our concepts and in our labels for the phenomena. For example, what previously would have been considered demonic possession might now be classified as a dissociative disorder. But in other cases, we retain our original vocabulary. The phenomena once called earthquakes are still called earthquakes even though we can now explain them in terms, like *plate subduction*, that were previously not part of our conceptual arsenal. And of course, before we had the insights of plate tectonics at our disposal, we had no qualms about claiming that the collapse of buildings was caused by an earthquake.

But the crucial point here is that our explanatory uncertainty was never a barrier to forming and using the concepts in the meantime, even if that meant we had to define the concepts for a while with respect to some level of ignorance. And we're usually content with that because we know that as science proceeds, we usually find new ways of systematizing observed regularities and drawing explanatory links between them and other things we observe or believe about the world. We knew that objects burned in combustion, whether we explained what we observed with respect to phlogiston or oxygen. Various symptoms of disease and ill health have been recognized for millennia, whether those conditions were explained in terms of imbalance of bodily humors, demonic influence, or micro-organisms. Even very unusual phenomena, such as instances of exceptional ("photographic") memory and the appearance of musical or mathematical prodigies and savants, occur indisputably, even though we're still struggling to explain them.

But no matter how we characterized and organized these occurrences and tried to connect them with other items in experience, we had concepts to operate with, for which we sought scientifically satisfying analysis, but which in the meantime we couldn't define analytically.

Furthermore, the complaint that parapsychological terms are only defined negatively seems to rest on a perniciously naïve tacit assumption—namely, that any phenomenon worthy of scientific attention must have an *analysis*, and in particular, an analysis in terms of respectable and presumably lower-level phenomena (e.g., explaining heat in terms of molecular motion, or earthquakes in terms of plate tectonics). But that seems to require that psi phenomena, and mental and behavioral phenomena generally, can't be irreducible or basic.

As I've remarked elsewhere (no doubt ad nauseum), most scientists wittingly or unwittingly subscribe to what I've called the *small-is-beautiful assumption*. According to that assumption, there can't be unanalyzable phenomena or facts at the observable level. But this is not only indefensible, it's downright peculiar. Scientists agree, reasonably, that explanation by analysis (i.e., into constitutive lower-level processes) can't continue indefinitely. In other words, they admit that some processes and regularities in nature are primitive in the sense that we can't go behind or beneath them and profitably ask *how* they occur. *That* they occur is simply a basic fact about the way the universe works, and there are no deeper (lower-level) corresponding regularities that explain why. Put another way, we can't always expect a general and context-independent answer to the question: How is phenomenon *P* possible? Some things simply *are* possible. Moreover, by acknowledging this we can avoid positing an infinite regress of analytical explanations and arrive at one kind of scientific ground level.

Now so far, this is fine; there's no problem in holding that some facts or regularities in nature should be considered unanalyzable. However, most scientists go further and assume that these fundamental regularities can exist only at the level of the very small—say, the atomic, microscopic, biochemical, or neurological level, and never (say) at the level of observable behavior. But that's simply an assumption, not an empirically established fact, and I believe anti-mechanists have marshaled powerful arguments against it.

Moreover, stopping the search for vertical explanation at this point is neither unscientific nor a failure in understanding. In fact, it's a *victory* of understanding to figure out where analysis comes to an end and where regularities can't be analyzed further in terms of more primitive constitutive processes. Besides, not all explanation stops once we identify unanalyzable phenomena; only vertical explanation (explanation by analysis) grinds to a halt. Scientific explanations take many forms; explanation in terms of lower-level processes is only one of them.

Scriven's comments in this connection are also worth quoting. They concern what he called "the doctrine of explanation by assimilation."

> The proper first move in the scientific explanation of a novel phenomenon is reduction of it to pre-existing and well-understood ones. But of course this does not always work—it can never always work since there has to be at least one basic phenomenon for which it will not work. We are facing a situation in physics and parapsychology where it may fail on an unprecedented scale. But that is no limitation of science, only of simplicity. What is irreducible is not thereby inexplicable. This situation may require us to turn from "vertical explanation" (derivation) to "horizontal explanation" (analogy, correlation, etc.); but we may finally and correctly come to understand the new phenomena, the old supernatural, just as well as any other fundamental phenomenon. (Screven, 1976, p. 194)

So I suggest we ignore the tired skeptical complaint that parapsychology is hobbled by its reliance on so-called negative definitions. The complaint is naïve and shallow, no matter how loudly or frequently some parapsychologists and psi-skeptics express it. As Mark Twain once noted: "Noise proves nothing; often a hen who has merely laid an egg cackles as if she had laid an asteroid."

NOTE

[1] As I've pointed out elsewhere (Braude, 2007) in connection with astrology.

REFERENCES

Braude, S. E. (1997). *The limits of influence: Psychokinesis and the philosophy of science* (rev. ed.). University Press of America.

Braude, S. E. (2002). *ESP and psychokinesis: A philosophical examination*. Brown Walker Press.

Braude, S. E. (2007). *The gold leaf lady and other parapsychological investigations.* University of Chicago Press.

Scriven, M. (1976). Explanations of the supernatural. In S. C. Thakur (Ed.), *Philosophy and psychical research* (pp. 181–194). Humanities Press.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 267–286, 2021 0892-3310/21

RESEARCH ARTICLE

EEG Activity During Mental Influence on a Random Signal Generator

William Giroldini

The Italian Association for Psychical Research (AISM), Milan, Italy
wilmayas@tin.it

Luciano Pederzoli

EVANLAB, Florence, Italy

Submitted July 24, 2020; Accepted December 23, 2020; Published June 15, 2021

https://10.31275/20211909

Abstract—This preliminary study is based on 38 experimental sittings in which 22 participants attempted to mentally influence an electronic circuit called RSG (Random Signal Generator), while their cerebral activity was recorded by a 14-channel EEG. Subject to sampling, signal peaks with an absolute value greater than a predetermined threshold were selected from the analogical RSG output by a computer program. Whenever a signal exceeded the threshold, an audible 'beep' sounded and the participant was asked to mentally increase the frequency of these beeps as much as possible, because a higher beep rate meant a successful mental influence attempt on the RSG. An important objective was to verify the existence of any relationship between a successful mental influence on the RSG and cerebral activity in the participant attempting the influence. Compared with an equal number of 'inactive' sittings made without anyone attempting mental action, the 'active' sittings show a small increase in the average number of beeps/minute, but in particular a significant increase in the emitted beeps within 1.5 s of the previous beep ($p < 0.025$). The experimental sittings were divided into two groups (with about 50% of participants in each), of which the first had better results, and only the frontal and fronto–temporal symmetrical EEG locations (AF3, AF4, F7, F8, F3, F4, Fc5, Fc6) were examined. The better-performing group showed a significant reduction in Brain Synchrony ($p < 0.03$) together with an equally significant increase in Beta and Gamma 15–42 Hz activity ($p < 0.03$). These differences were interpreted as an effect of greater mental work performed by the better-performing group during mental influ-

ence on the RSG. This study contributes to investigating the relationship between EEG activity and mind–matter (PK) interaction at a distance, in order to find, if any, a significant relationship between PK effects and brain waves.

Keywords: mind–matter Interaction, psychokinesis, entanglement, EEG, ERP, RNG, brain–computer interface, random signal generator, mentally controlled devices

INTRODUCTION

This study presents the results of a series of experimental sittings aimed at investigating the mind–matter (PK) interaction by means of the mental influence on a Random Signal Generator (RSG) with a simultaneous recording of the electroencephalogram (EEG) of the subject attempting the mental influence. This procedure represents an interesting innovation with respect to previous studies, in which the PK influence effect on an electronic device usually involved a Random Number Generator (RNG) of which the output was simply a sequence of zeros and ones. One of the most ambitious objectives of RNG (and similar) studies is in fact to verify the possibility of distantly activating electronic devices at will simply by using "mind force."

Even though, given the current state, this possibility of at-will activation is still far removed from present abilities, many studies—beginning in the 1970s by R. G. Stanford (1977), H. Schmidt (1987), and then by R. Jahn et al. (1997) under the scope of PEAR lab (Princeton Engineering Anomalies Research)—have produced to date hundreds of studies overall highlighting a weak but significant PK interaction effect (Bösch et al., 2006). Moreover, examples of previous RNG–PK studies considering EEG correlates include Heseltine (1977), Heseltine and Mayer-Oakes (1978), Schmidt and Terry (1976), and Radin et al. (2012, 2015).

Despite the still-common skepticism, it seems important to continue this type of research by integrating data obtained from the electronic device under examination with the simultaneous recording of mental activity via EEG—as in this case—or with other more sophisticated techniques. A better knowledge of mental states during PK action is of fundamental importance to demonstrate the reality of PK as well as understanding which traits of brain activity correlate with PK.

MATERIALS AND METHODS

Participants

22 people ranging in age from 30 to 70 years, 10 males and 12 females, took part voluntarily in the experiment, carried out in the AISM Laboratory (Milan, Italy).

The criteria used for participant selection were the following:

— interest in the experiment itself,
— convinced of the existence of psi, and
— having presumed personal experience of psi events.

Some participants who had particularly good results in PK action took part in more sittings, thus favoring a contribution by subjects who are more gifted in PK.

Ethics Declaration

The use of participants is in accordance with the ethical guidelines of the Declaration of Helsinki, and the study was approved by the AISM Ethics Committee. Before taking part in the experiment, all participants were informed of the study's objectives and gave their written consent to participate.

Equipment

In this study the traditional RNG (Random Number Generator)—currently also available as a USB—was substituted with an electronic circuit called a Random Signal Generator (RSG). The reason for this stems from the theory, confirmed by a previous study (Giroldini, 1991), that an RSG circuit could be more sensitive to PK than an RNG. Both types of circuits are based on white noise generated by low voltage Zener diodes when, for a quantum tunnel effect, they are given a small continuous current.

Conceptually, the RNG is based on only one Zener diode, the signal of which is amplified and then immediately split and thereafter digitalized (Pederzoli et al., 2017) and processed, and on its emergence gives a regular temporal sequence of absolutely random 1 and 0 states.

This process could, however, hinder sensitivity to PK, since in a post-digitalization stage the 1 and 0 states are further processed, causing the loss of a good chunk of the possible relationship with mental influence on the tunnel effect.

The RSG circuit used in this study is instead composed of 16 identical generators/amplifiers of white noise each using a Zener diode and an operational amplifier. Their output signals are then added and amplified by another operational amplifier, producing the RSG's final output signal. The signal produced by individual generators is totally random; therefore the sum of the 16 signals is also random with respect to noise, increasing the output voltage as the square root of the number of generators (following the sum of their powers, not voltages).

We assume, though, that PK acts simultaneously and in the same manner on all 16 white noise generators, so that all their voltage contributions are added together at the output: We therefore expect that the signal/noise ratio relative to the PK of the whole circuit improves by a factor equal to the square root of the number of generators, in this case 4 times with respect to a single generator. The circuit diagram of the RSG is shown in Figure 1.

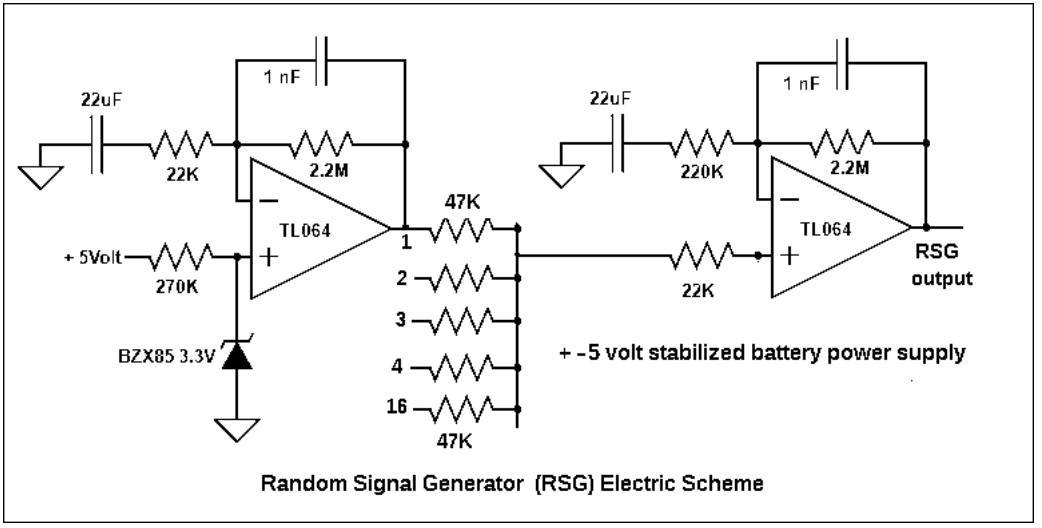


Figure 1. Circuit diagram of the Random Signal Generator. There are 16 equal white noise generators, like that on the left. The circuit on the right adds together all their signals, amplifies them, and produces the RSG's output signal.

In this study the RSG circuit was battery-operated with a stabilized voltage and enclosed inside a shielded metal box. During the session the ambient temperature was set at 23.5 +/– 0.5 °C, giving the RSG time to thermally stabilize. The RSG circuit's output signal was lastly AC-amplified by a second battery-powered device with a 1–40 Hz bandwidth (Brain Monitor, Elemaya, Milan, Italy). The RSG signal at this stage is then a typical AC (alternate current) signal with average value Mv experimentally adjusted about half-scale of the ADC output. This constant value Mv was used successively for all the experiments in order to determinate peaks of RSG activity. The RSG signal was then sampled at 128 samples/s and 8 bits/sample, and then sent in digital form to the processing computer through an RS232 serial port.

The EEG was an Emotiv Epoc model modified to connect (via a multi-contact connector) to a Bionen (Florence, Italy) professional headset so that high-quality EEG signals could be detected.

The entire system was carefully checked for accuracy and quality of recorded signals. Sampling frequency was 128 samples/s over 14 channels connected to the following location points: AF3, F7, F3, Fc5, T7, P7, O1, O2, P8, T8, Fc6, F4, F8, AF4. All electrodes referred to two interconnected aural electrodes (A1 and A2).

The Emotiv Epoc was equipped with a fifth-order, synchronous, low-pass digital filter (band 0.2–45 Hz) and also two notch filters at 50 and 60 Hz, respectively, to protect against disturbances from the local electricity network; it also had its own wireless connection to the computer, at a frequency of 2.4 GHz, so as to totally isolate the acquisition electronics.

A special computer program also was created, dedicated to simultaneous acquisition of both EEG and RSG signals, all at the sampling frequency of 128 samples/second. Additionally, the program managed the emission of a short beep (500 Hz, 60 ms duration) that was given to the participant through headphones with a 32 Ohm impedance each time the RSG signal exceeded a certain threshold 'Th', the value of which was determined so that a statistical average of 30 beeps/minute would be a baseline activity in the absence of mental influence attempts on the RSG.

Each time the threshold was exceeded, the program prevented the emission of other beeps (even if successive signals exceeded the

threshold) for a duration equal to 100 samples (0.78 sec), but the entire RSG signal continued to be recorded together with EEG signals. An excessive number of beeps within too short a time interval would have prevented the clear distinction between normal EEG responses to a brief audio or visual stimulus, which are defined as ERPs and described in more detail below.

A computer with the Windows XP operating system was used to stabilize time-setting, because it is far better than the ubiquitous Windows 10. All the hardware used in this study is shown in Figure 2. This arrangement has been proven effective in ensuring that RSG signals remain unaffected by external disturbances and the EEG signals themselves.

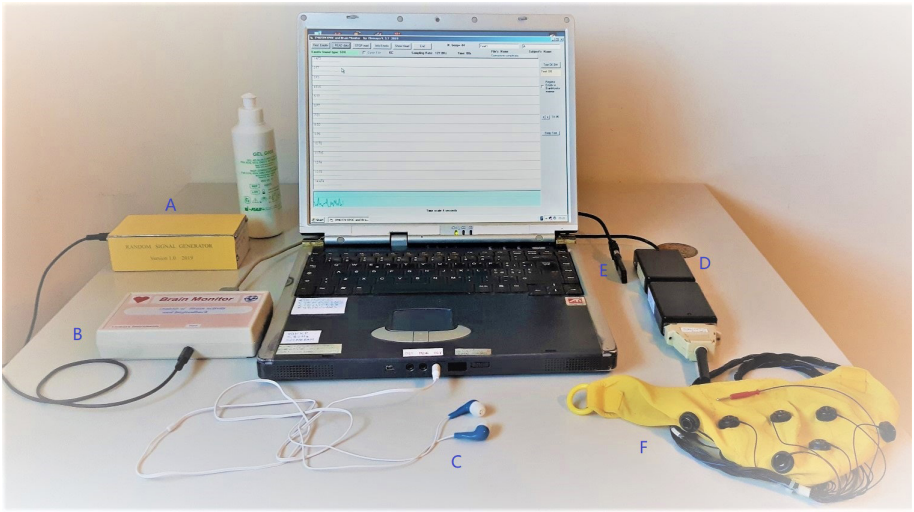


Figure 2. Hardware used in this study. Computer + A = RSG, B = amplifier and analog/digital converter, C = headphones, D = modified Emotiv Epoc, E = 2.4 GHz USB receiver, F = EEG headset.

Procedure

To stabilize temperature, all the equipment was placed in the laboratory where the experiments would take place and turned on at least one hour before each sitting; the ambient temperature was set to between 23°C and 24°C.

After fitting the headset on the participant's head, applying conducting gel to the electrodes, and carefully checking the quality of all signals, the participant was instructed to try to listen for as many generated beeps/min as possible, because a higher beep frequency indicated a more effective mental influence on the RSG. The experiments were in fact conducted based on the theory that feedback in real time would have enhanced the effectiveness of voluntary mental action.

The participants, who were usually relaxed, very motivated, and sitting on a comfortable chair, were instructed to keep their eyes closed and to limit physical movements during the test, so as to obtain the best possible EEG signal quality.

At this point the test began, lasting around 16 minutes, with the computer program signaling its end. For each session a control test was undertaken immediately after, or sometimes shortly before the session, with nobody in the laboratory. Obviously in these control tests the only channel recorded for 16 minutes, with the same program, was that relative to RSG output. The 38 experimental sittings, together with 38 controls, were achieved over 3 months of work, and, as already stated, some subjects who obtained good results were invited to take part in more sessions.

RESULTS

Data Analysis

Each session produced a total of three files: one with EEG data, one with RSG activity, and also, during the control phase (CT), a file with the recording of the RSG's activity. Each output signal of the recorded RSG was then subjected to a series of statistical processes, among which was a calculation of the average amplitude of the RSG signals during the PK and CT phases, the statistical distributions of their sample values, as well as their frequency distributions via FFT. There was no significant difference between the PK and CT data. Each 'beep' perceived by a participant originated from an RSG activity peak: Henceforth, this peak will be defined simply as "Peak." Peaks generated by the RSG were ascertained by calculating the absolute value of the RSG's signal after subtraction of its average value and checking to see if it exceeded the pre-determined Th threshold. A Peak occurred

when Abs[RSG(t) – Mv] > Th, with Mv = average value of RSG signal as described previously. Figure 3 shows the absolute value of the RSG signal as a function of time, and the horizontal grey line represents the threshold Th.

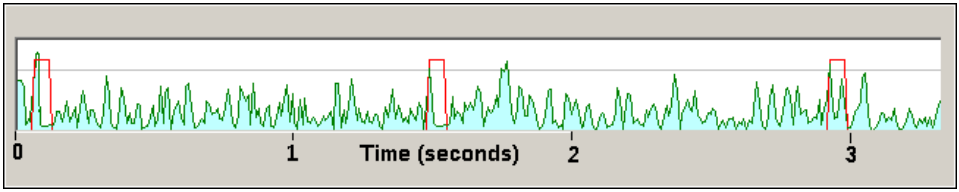


Figure 3. Graphic example of the RSG (full wave rectified signal via computer program). When the RSG signal exceeded (Peak) the established threshold (horizontal grey line), a short beep was emitted (red curve), after which, for 0.78 s and despite the possible presence of other Peaks, no other beeps were emitted.

The average number of Peaks/minute during the PK phase was slightly higher with respect to the control phase: 31.125 Peak/minute (*SD* = 2.316) compared with 30.636 Peak/minute (*SD* = 2.03), *N* = 38. This difference cannot be considered significant; however, some participants reported having had the sensation of beeps in very close succession followed by longer than normal pauses. Consequently, instead of limiting the study to simply counting Peaks/min, we analyzed the distribution of Peaks over time in order to find asymmetries between the PK and CT phases. The difference in time ΔTx between the two Peaks is defined by the equation:

$$\Delta Tx(i) = Tx(i) - Tx(i-1)$$

where Tx(i) is the absolute time of each Peak (expressed as seconds or as samples).

During a 16-minute test, there are about 500 Peaks, corresponding to 500 values of ΔTx. This set of ΔTx values can be distributed as small intervals of time, denoted 'bins', each being 10 sample durations (0.781 s) such that each single ΔTx must fall within a bin. For example, bin number 30 contains the ΔTx values from 2.343 s to 2.422 s inclusive, or between 300 and 310 samples (of the RSG signal).

In this way we can create a group of bins (k), each of which contains the number of ΔTx falling within a certain time interval. It is

then possible to acquire the statistical distribution of times between two successive Peaks and compare the distribution of PK and CT bins, as shown in Figure 4, which illustrates the global average of bin distributions from all tests.

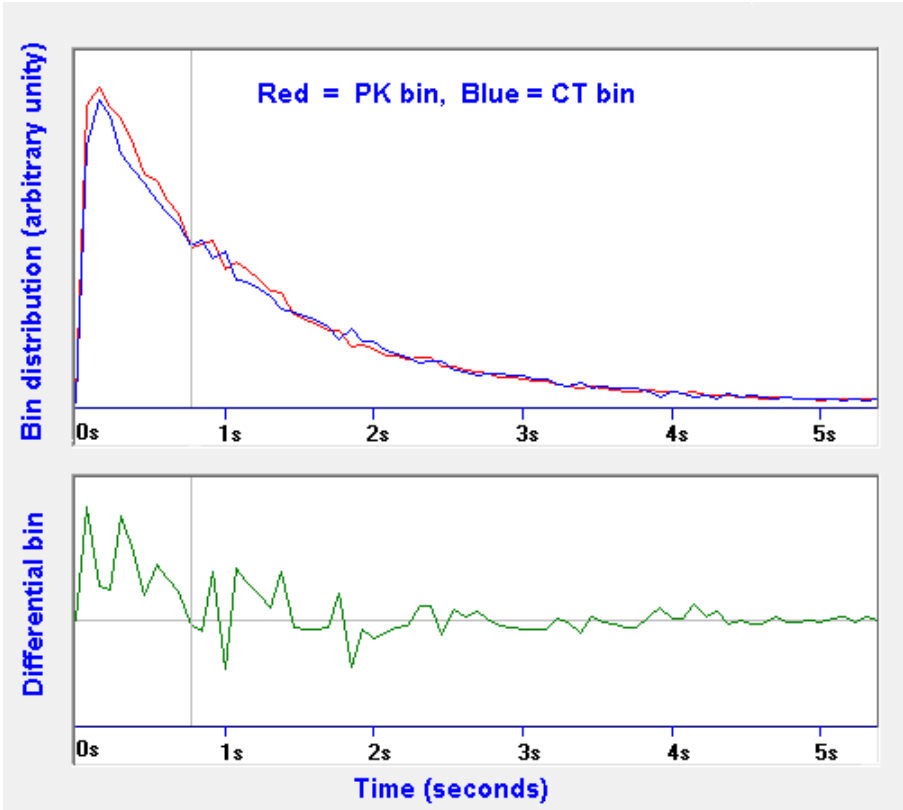


Figure 4. Final average distribution of bins between PK and CT. Included are bins corresponding to times < 0.781 s, which do not cause emission of a beep.

We see that the PK line is mostly above the CT line until about 1.5 s, while the average lag between Peaks is around 2 s.

In consonance with bins < 0.781 s, the program does not emit any beeps; however, even in bins lower than 0.78 s we see an excess of Peaks. The excess Peaks during the PK attempts with respect to controls (CT) seems more evident in the lower graph, which represents the difference between the two curves. To statistically evaluate excess bins

up to around the 1.5-s mark, it was decided to calculate (for each of the 38 PK and CT files) the ratio between the sum of all bins between 0 and 1.5 s inclusive and the sum of all bins between 1.5 s and 4.0 s inclusive.

The ratio is an adimensional number pertaining only to the temporal distribution of Peaks and not their absolute number; furthermore, from specific tests carried out, it has been shown to be indifferent to variations in the RSG signal caused by ambient temperature in the range between 18 and 30 °C. The average value of these ratios, for all the PK and CT tests, was calculated in two time intervals (A & B), as shown in Table 1.

The differences between PK and CT are important for both data

TABLE 1
Significance of Ratio between Two Time Intervals A and B Including and Excluding Bins < 0.78 s (*SD* = standard deviation of 38 results)

Intervals	PK ratio A/B	CT ratio A/B	Student's *t*	Probability
A = 0–1.5 s **B = 1.5–4.0 s**	5.45 *SD* = 1.54	4.84 *SD* = 1.07	2.00	$p < 0.025$
A = 0.78–1.5 s **B = 1.5–4.0 s**	3.77 *SD* = 0.88	3.43 *SD* = 0.59	1.92	$p < 0.03$

including audio feedback (for t > 0.781 s) and data without feedback. The sensation reported by some participants who reported hearing rapid sequences of beeps was thus shown to be correct and statistically significant.

We also note that the standard deviation of the PK data is decidedly higher than the CT control data. It's highly probable, in some subjects, that this can be attributed to the presence of flurries of Peaks in rapid succession caused by PK mental action on the RSG.

Henceforth, the value of the "PK ratio A/B" (shown in Table 1, line 1) will be called "PK effect." The value of the PK effect will be used to divide the trials into two groups, as described in the following paragraph.

DISCUSSION

Analysis of EEG Signals

EEG signals were subjected to a pre-processing stage comprising high-pass filtering at 0.8 Hz, followed by signal normalization and their filtration in the 1–42 Hz band, followed by storage of these EEG files for further analysis. Normalization of EEG signals was necessary in that the signals can vary in amplitude by as much as a factor of 3 between subjects and must be made uniform as much as possible for ease of processing.

After carrying out the above pre-processing, the signals were analyzed using the Fourier transform (FFT) on contiguous intervals of 1 s, with a rectangular window and no overlap, to define their frequency distribution between 1 and 42 Hz with a resolution of 1 Hz. These procedures were performed for each session, and the FFT overall average of all sessions also was calculated.

Moreover, to evaluate the degree of correlation—or 'synchrony'—between the different areas of the cerebral cortex, another parameter was defined and calculated and was called "Brain Synchrony." In the literature, many different methods can be found to calculate such 'synchrony', and often the results cannot be directly compared because of the different logical–mathematical procedures used. We can for example cite Perez et al. (2017), Thatcher et al. (2008), and Diwaker et al. (2016), who used methods based on a calculation of the Pearson correlation between two rough signals, or even between the envelope of frequencies of two signals given by the FFT, and so on, including more complex variations.

In this work the chosen procedure was the following: From the 14 EEG recordings of the 14 channels (Nc = 14), the Pearson linear correlation was calculated (for each 1-s interval), for a total of 91 correlations between all possible pairs of signals, as obtained from the following expression:

$$\text{Number of Correlations} = (Nc^2 - Nc) / 2 = 91$$

Using the PK effect defined above, the trials were divided into two groups. The first group contained 18 trials—called "PKgood"—who had obtained a PKeffect > 5.40, while the second group had 20

trials—called "PKbad"—with a PKeffect < 5.40. Then the two groups were compared using the average values of their Fourier analyses and the Brain Synchrony calculation of each of their 91 correlations.

Results are shown in Figure 5.

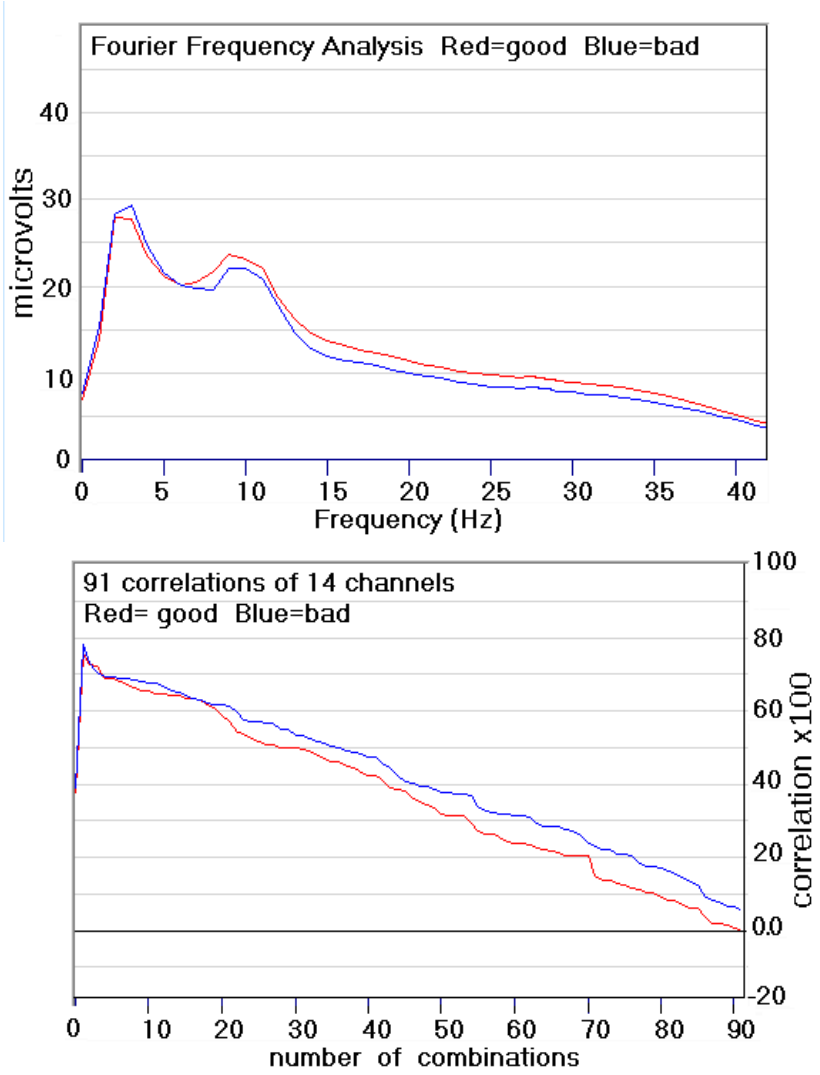


Figure 5. The top graph shows the Fourier analysis of two groups (PKgood & PKbad): We see that the PKgood group shows more intense Beta and Gamma activity (from 15 to 42 Hz). The bottom graph shows, in decreasing order, the 91 Brain Synchrony values of the two groups: We see that the PKgood group has a lower average value.

The graph relative to the Fourier analysis (top graph) shows that the PKgood group displays, in a statistically significant way (see Table 2), a more intense Alpha, Beta, and Gamma (15–42 Hz) activity compared with PKbad. The PKgood group also shows an average Brain Synchrony value (of correlations between all 91 electrode pairs) that is lower than that of the PKbad group. Furthermore, when Brain Synchrony was calculated only on the eight fronto–temporal EEG locations, the difference became statistically significant with $p < 0.025$ (Figure 6).

TABLE 2
Results from the PKgood and PKbad Groups in the Different EEG Bands and the Two Types of Synchrony

Frequency Band	PKgood		PKbad		Student's *t*	Probability (one-tail)
Delta (1–4 Hz)	27.2	*SD* = 3.2	28.22	*SD* = 3.5	*t* = 0.92	**n.s.**
Theta (4–8 Hz)	19.5	*SD* = 2.4	18.3	*SD* = 2.8	*t* = 1.42	**n.s.**
Alpha (8–12 Hz)	20.8	*SD* = 2.9	18.9	*SD* = 3.6	*t* = 1.80	$p < 0.05$
Beta & Gamma (15–42 Hz)	9.3	*SD* = 1.7	8.1	*SD* = 1.9	*t* = 2.05	$p < 0.025$
General Synchrony	37.9	*SD* = 7.3	43.2	*SD* = 11.5	*t* = 1.71	$p < 0.05$
Frontal Synchrony	41.1	*SD* = 7.3	47.1	*SD* = 10.2	*t* = 2.10	$p < 0.025$

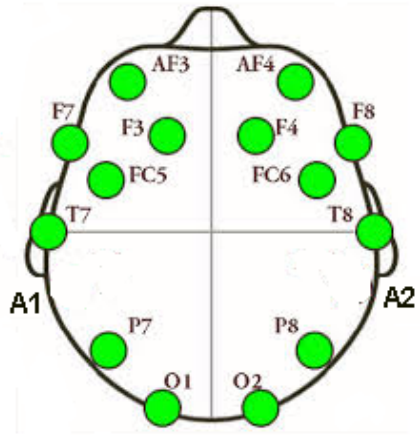


Figure 6. The PKgood group displays a lower Synchrony value compared with the PKbad group, especially in the fronto–temporal locations (AF3, AF4, F7, F8, F3, F4, Fc5, Fc6).

Neurophysiological Interpretation of Observed Differences

Generally, in the literature, for example in Adewale and Panoutsos (2019) and Roy et al. (2016), the increase in EEG activity in Theta, Beta, and Gamma ranges is associated with an increase in mental workload, while Alpha activity depends on circumstances. The observed decrease in the PKgood group's Brain Synchrony can also be associated with an increase in mental workload, in other words more intense attention and effort toward a mental task, in this case being the attempts at influence on the RSG to obtain more frequent beeps. As mentioned above, it is difficult, if not impossible, to compare Brain Synchrony (or Coherence) data in the literature because of the logical–mathematical methods used, which strongly differ among studies; however, it seems reasonable to conclude that the PKgood group obtained better results because the participants put in greater mental effort in the influence attempt on the RSG, producing greater mental work.

Also, in a study by W. Giroldini (2020) dedicated to NeuroMarketing and titled "EEG global response to videoclips and NeuroMarketing," which is based on the same analysis methods used in this work, the EEG activity of many subjects was recorded both before and while watching videos, requiring attention and mental effort: The results were perfectly commensurate with those presented in this work. It was found that during the viewing of these videos there was a reduction in Brain Synchrony and a significant increase in activity within the Theta and Gamma ranges, while activity in the Alpha range decreased a little. In particular, if subjects have their eyes closed (such as in this study's PK tests), the Alpha signal may increase, whereas when watching a video with eyes open the signal in the Alpha band normally decreases.

Analysis of the ERPs (Event Related Potentials)

Participants in the study would hear a short beep each time the RSG's output signal exceeded, in absolute value, the pre-determined threshold. Each short auditory stimulus, like a beep, had a corresponding characteristic ERP (Event Related Potential) well-known and described in the scientific literature and commonly used in Neurology. The EEG signals were filtered in the Alpha band (8–12 Hz) and therefore the time-locked epochs corresponding to the beeps were mediated according to

the standard procedure for obtaining participants' ERPs.

To then obtain the average ERP of many participants, instead of just calculating the simple average of EEG signals (using the stimulus start as a reference point)—with its resulting effect of partial reciprocal cancellation due to time lags between the ERPs of different subjects—we preferred to use signal power (which does not have this disadvantage) according to the following formula:

$$ERP = \sum_{i=1}^{N} S(x)^2$$

S(x) is a temporal window (x = samples index) synchronized with a single beep and extracted from each channel of one session, and *N* is the number of beeps (and therefore of ERPs). The temporal window is 4 s, with a stimulus (labeled 0) after 1.5 s. The global result (Figure 7) shows a totally normal auditory ERP.

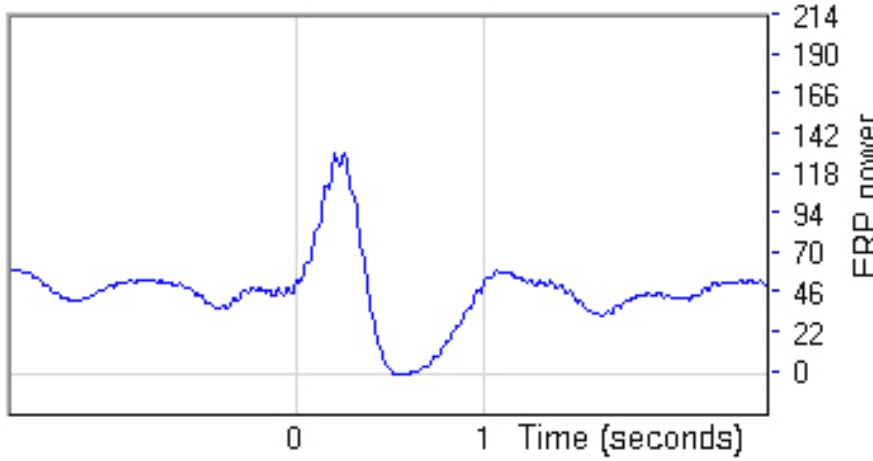


Figure 7. Global auditory ERP of all 38 participants. The acoustic stimulus (beep) was given at time zero. We see the typical response peak after about 260 ms, followed at first by a dimming of the EEG signal strength and then by a return to base level after about 1 s.

Nonetheless, the simple average in Figure 7 derives from acoustic stimuli separated by lags ranging from 0.78 s up to many s. If we add together ERPs separated by less than 1 s, inevitably the tail of one ERP is added to the next ERP. Indeed, if we add up only the ERPs separated

from each other by less than 1 s, we get the graph in Figure 8.

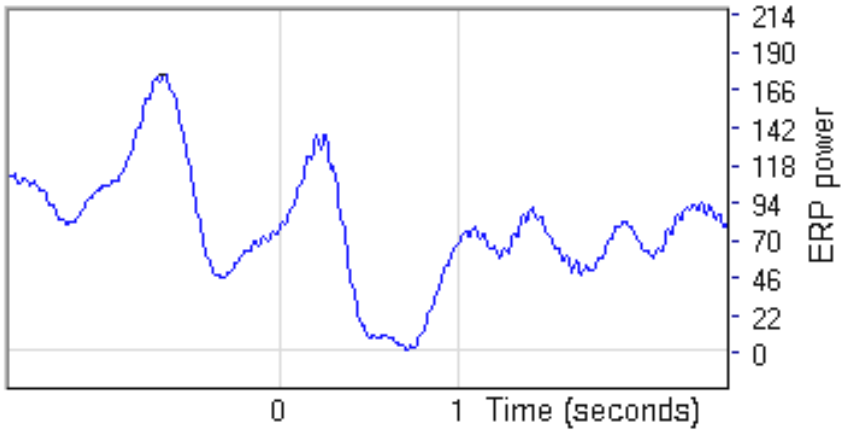


Figure 8. Adding up ERPs separated from each other by less than 1 s, we clearly see the preceding ERP during the pre-stimulus phase.

If instead we add together all the ERPs with separation > 1.2 s, we get the graph in Figure 9.

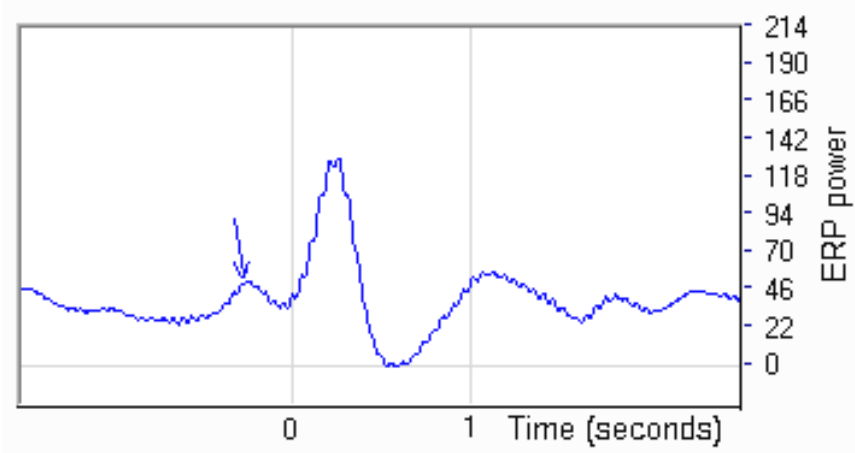


Figure 9. Graph obtained by adding together ERPs separated by at least 1.2 s. Immediately before the stimulus, we see a peak, indicated by the arrow.

In this graph, in the pre-stimulus period just before the stimulus itself, we see a peak (indicated by an arrow) which remains even when the stimuli are separated by more than 2 s. We see this pre-stimulus

peak by filtering the EEG signals in the 8–12 Hz band (Alpha) and 12–15 Hz band (called Sensory–Motor).

Finally, as a control study, 13 sessions were carried out, each with 480 beeps and two participants chosen from the PKgood group: The auditory stimuli were administered in the same way (through headphones) and were identical in intensity, duration, and number to those in the main study. They were, however, randomly separated from each other, by means of a program based on a pseudo-RNG generator, with intervals of 2 to 3 s inclusive. The participants were well aware of being unable to modify in any way the temporal distribution of beeps and were therefore asked to passively listen to the sequence (Figure 10).

The result of this short control series is shown in Figure 9, with

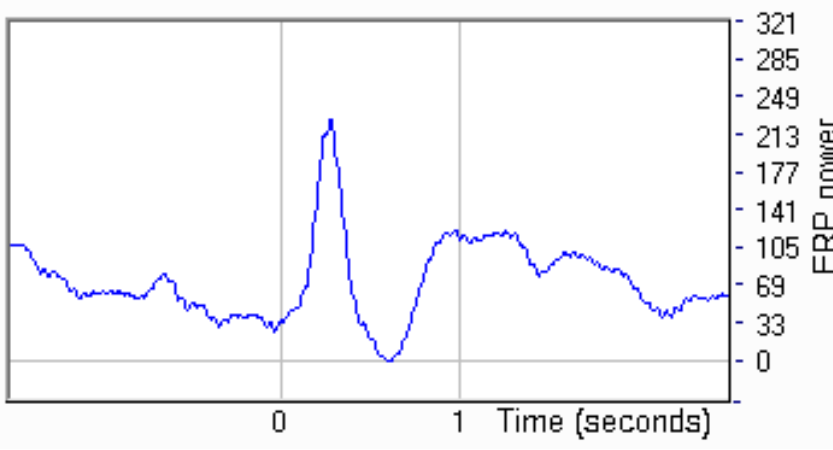


Figure 10. A series of 13 control sessions with 480 beeps administered to two PKgood participants using a software based on pseudo-RNG, showed no peak before the ERP.

EEG signals filtered in the 8–12 Hz band, which shows no pre-stimulus peak. The pre-stimulus peak is not, at this stage, attributable with any certainty to any precise cause and could simply be an unimportant statistical anomaly. Naturally it would, however, be very interesting if it were a small effect of an activation of the participant's brain about 0.2 s before he/she elicits a PK effect on the RSG, which produces a Peak and therefore a beep leading to an acoustic ERP.

Prinz (1997) writes: "There are certain products of perception on the one hand and certain antecedents of action on the other that share

a common representational domain" (see also Melnik et al., 2017). We could perhaps theorize that the desire to 'hear more beeps' generates neural activity similar to that associated with a voluntary action (e.g., muscular), but prior to it. This effect that precedes voluntary action usually occurs exactly within the 8–15-Hz range, i.e., in the Alpha and Sensory–Motor range. On the other hand, if we filter EEG signals from this study in a range like the Delta–Theta (between 1 and 8 Hz, and with ERPs separation > 1.2 s), we don't see any pre-stimulus peak, only the normal ERP.

CONCLUSIONS

This exploratory study suggests that when the cerebral activity (via EEG) of a person attempting to mentally influence a random signal generator, and the RSG's signal itself, were simultaneously recorded, we see not only that the PK effect on an RSG is possible, but also that it could be associated with specific cerebral psychophysiological variations. Of special interest is the emergence of EEG characteristics consistent with substantial mental effort during the intent to influence the RSG. The potential for this new research field is broad and is worth independent replication.

Finally, it is worth highlighting the, for now, only circumstantial existence of cerebral activation preceding the post-beep resulting ERP. If this cerebral activation before a Peak generated by mental action on the RSG were to be confirmed, it would be an important step forward in the understanding of mind–matter interaction.

REFERENCES

Adewale, Q., Panoutsos, G. (2019). Mental workload estimation using wireless EEG signals. bioRxiv preprint. https://www.biorxiv.org/content/10.1101/755033v1 https://doi.org/10.1101/755033

Bösch, H., Steinkamp, F., & Boller, E. (2006). Examining psychokinesis: The interaction of human intention with random number generators—A meta-analysis. *Psychological Bulletin, 132*(4), 497–523. https://doi.org/10.1037/0033-2909.132.4.497

Diwaker, S., Gupta, S. K., & Gupta, N. (2016). Classification of EEG signals using correlation coefficient among channels as features extraction method. *Indian Journal of Science and Technology, 9*(32). htpps://doi.org/10.17485/ijst/2016/v9i32/100742

https://www.researchgate.net/publication/308127706_Classification_of_EEG_Signal_using_Correlation_Coefficient_among_Channels_as_Features_Extraction_Method

Giroldini, W. (1991). Eccles's model of mind–brain interaction and psychokinesis: A preliminary study. *Journal of Scientific Exploration, 5*(2), 145–161.

Giroldini, W. (2020). EEG global response to videoclip and Neuromarketing. (Submitted paper.) https://www.researchgate.net/publication/342779717_EEG_global_response_to_videclip_and_NeuroMarketing

Heseltine, G. L. (1977). Electronic random number generator operation associated with EEG activity. *Journal of Parapsychology, 41*, 103–118.

Heseltine, G. L., & Mayer-Oakes, S. A. (1978). Electronic random generator operation and EEG activity: Further studies. *Journal of Parapsychology, 42*, 123–136.

Jahn, R. G., Dunne, B. J., Nelson, R. G., Dobyns, Y. H., & Bradish, G. J. (1997). Correlations of random binary sequences with pre-stated operator intention: A review of a 12-year program. *Journal of Scientific Exploration, 11*(3), 345–367.

Melnik, A., Hairston, W. D., Ferris, D. P., & König, P. (2017). EEG correlates of sensorimotor processing: Independent components involved in sensory and motor processing. *Scientific Reports, 7*, 4461. https://www.nature.com/articles/s41598-017-04757-8

Pederzoli, L., Giroldini, W., Prati, E., & Tressoldi P. (2017). The physics of mind–matter interaction at a distance. *NeuroQuantology, 15*(3), 114–119.
https://www.researchgate.net/publication/327614649_The_Physics_of_Mind-Matter_Interaction_at_a_Distance
https://doi.org/10.2139/ssrn.2968430
https://doi.org/10.14704/nq.2017.15.3.1063

Perez A., Carreiras, M., & Andoni Duñabeitia, J. A. (2017). Brain-to-brain entrainment: EEG interbrain synchronization while speaking and listening. *Scientific Reports, 7*, 4190. https://www.nature.com/articles/s41598-017-04464-4

Prinz, W. (1997). Perception and action planning. *European Journal of Cognitive Psychology, 9*(3), 129–154.

Radin, D. I., Michel, L., Galdamez, K., Wendland, P., Rickenbach, R., & Delorme, A. (2012). Consciousness and the double-slit interference pattern: Six experiments. *Physics Essays, 25*(2), 157–171.

Radin, D., Michel, L., Pierce, A., & Delorme, A. (2015). Psychophysical interactions with a single-photon double-slit optical system. *Quantum Biosystems, 6*(1), 82–98. https://doi.org/10.4006/0836-1398-25.2.157

Roy, R. N., Charbonnier, S., Campagne, A., & Bonnet, S. (2016, April). Efficient mental workload estimation using task-independent EEG features. *Journal of Neural Engineering 13*(2), 1–10. https://pubmed.ncbi.nlm.nih.gov/26877162/
https://doi.org/10/1088/1741-2560/13/2/026019

Schmidt, H. (1987). The strange properties of psychokinesis. *Journal of Scientific Exploration, 1*(2), 103–118.

Schmidt, H., & Terry, J. C. (1976). Search for a relationship between brainwaves and PK performance. In W. G. Roll (Ed.), *Research in parapsychology* (pp. 30–32). Scarecrow Press.

Stanford, R. G. (1977). Experimental psychokinesis: A review from diverse perspectives. In B. B. Wolman (Ed.), *Handbook of parapsychology*. Van Nostrand.

Thatcher R. W., North, D. M., & Biver C. J. (2008, December). Development of cortical connections as measured by EEG coherence and phase delays. *Human Brain Mapping, 29*(12), 1400–1415. https://doi.org/10.1002/hbm.20474 https://www.researchgate.net/publication/5887520_Development_of_Cortical_Connections_as_Measured_by_EEG_Coherence_and_Phase_Delays

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 287–310, 2021 0892-3310/21

RESEARCH ARTICLE

Mind–Matter Entanglement Correlations: Blind Analysis of a New Correlation Matrix Experiment

Hartmut Grote

Max Planck Institute for Gravitational Physics, Hannover, Germany

Submitted August 6, 2020; Accepted January 4, 2021; Published June 15, 2021

https://10.31275/20211931

Abstract—The work reported here is a rigorous conceptual replication of the so-called "Correlation-Matrix" experiment by an independent author. The experiment has been built from scratch with new hardware and software, testing 200 participants who have spent about half an hour each trying to 'influence' a physical random process visualized for feedback. The analysis software has been conceptualized following a strict blind analysis protocol. Blind analysis is a more rigid form of pre-registered analysis, in which the complete analysis software is written and tested before the data are actually analyzed for the effect under study. The unblinding of the analysis, also called the 'opening of the box', of the experiment described here was performed live at the Parapsychological Association convention in 2019 in Paris. The main result was found not to be statistically significant and fell well within the expected random distribution of possible results. A second experiment, also following a blind analysis protocol, included questionnaires that were correlated with the participants' performance to 'influence' the physical random process (the main psi task). This yielded a probability of $p = .06$ to have occurred by chance, under a null hypothesis. A post hoc analysis of the hit rate for the psi task across all participants, which is mathematically independent from the correlation analysis, yielded a probability of $p = .06$ as well, to have occurred by chance. Three unexpected anecdotal incidents that occurred during the execution of the experiment and the testing and actual analysis of the data may add to the canon of oddities and trickster-like effects sometimes reported in parapsychology research.

Keywords: mind–matter, entanglement, parapsychology, Correlation Matrix

INTRODUCTION

Mind–matter interaction or micro-psychokinesis (PK) experiments have a long tradition in parapsychology and, due to inherent difficulties in these experiments, often have become more complex in their nature over the years. One of these more complex developments was to use *correlations* between psychological variables of a human agent with actual physical variables of a system. For example, instead of looking for an aggregate deviation from randomness, one would correlate the output of a random number generator (RNG) with psychological traits such as belief in parapsychological phenomena, or others. An additional level of complexity was introduced by Walter von Lucadou by using *many* such correlations between different psychological and different physical variables within one experiment. Arranging all the resulting correlation factors in a matrix, he called this type of experiment the "Correlation Matrix Method" (CMM) (von Lucadou 1986, 1991, 2006). To evaluate statistical significance of a potential psi effect, all correlation factors in the matrix have to be evaluated together, as an ensemble.

The idea of the CMM method was created in conjunction with the hypothesis that psi may act in the form of correlations, rather than in the form of a causal signal transmission. In an analogy to physics, such hypothetical entanglement-like correlations could not be used to reliably transmit information, which would make it unpredictable where in a given PK-type experiment significant correlations would show up. Thus, the combined result of many correlations is evaluated in a CMM-type experiment, without predicting or expecting any particular correlation to show significance. In essence, this is a multiple-analysis technique. The idea of a CMM-type experiment has also been related to the theoretical backgrounds of Generalized Quantum Theory (Filk & Römer, 2011) and the model of pragmatic information (von Lucadou, 1995).

Von Lucadou performed three such CMM-type experiments and reported statistical significance for each of these (von Lucadou 1986, 1991, 2006), which has lately led to a new replication involving von Lucadou and other researchers (Walach et al., 2020). There has been some debate about a statistically correct method to evaluate the significance of the ensemble of correlation factors in the matrix.[1] At

present, empirical methods (based on permutations and/or simulations of data) to estimate the statistical background distribution, as proposed and applied by Grote (2015, 2017), seem to be the only viable method. The reason for this is that in virtually all correlation matrix experiments performed to date, there are strong correlations between the psychological variables obtained, which renders all analytical statistical methods, which usually rely on statistical independence, invalid. The work by Walach et al. (2020) has followed this empirical approach to estimate the statistical significance and obtained less significant results than were reported by von Lucadou (1986, 1991, 2006).

In his two earlier experiments (von Lucadou, 1986, 1991), von Lucadou used questionnaires to obtain psychological variables *before* the physical variables, derived from RNG output, were obtained. In his later experiment (von Lucadou, 2006), as well as in the replication (Walach et al., 2020), this design was changed to using the choice of button pushes by the participants as psychological variables. These variables from button pushes were obtained during individual runs (see details below) and correlated to physical variables from RNG output of earlier runs, the same run, and later runs. The correlation of psychological variables to physical variables (which are presented as feedback to the participant and thus may influence the psychological variables) from earlier runs and the same run has led to some controversy about possible causal correlations. While there seems to be no hint of causal correlations in the data of the experiments described by von Lucadou (2006) and Walach et al. (2020), it seems more prudent to use only psychological variables that have been obtained *before* the physical variables, if truly non-causal correlations are to be elucidated and investigated.

In the study reported here, the choice was made for a 'button-push' scheme, as in the studies by von Lucadou (2006) and Walach et al. (2020), but to only use psychological variables obtained *before* physical ones for the main analysis. We call this 'Experiment 1' of this study, as submitted to the Bial Foundation. In addition to this experiment, each participant was asked to fill out a questionnaire before the apparatus-phase of the experiment. The questionnaires were planned to be correlated with the main RNG output across all participants, which we call 'Experiment 2'.

While Experiment 1 described here is a close conceptual replication of a CMM experiment facilitating the basic experimental design as used by von Lucadou and others, some notable differences will be pointed out. Experiment 2 is a conceptual replication of the work reported in Jolij and Bierman (2019).

METHODS

Experimental Apparatus

The experimental apparatus has been designed and built by the author of this study. The choice was made to build a new, dedicated hardware device rather than using a standard computer, to give the experiment some feeling of uniqueness. The device consisted of a case made of wood and metal, with a small (7-inch) high-resolution video screen and four dedicated push buttons, as shown in Figure 1.

Figure 1. The experimental apparatus. The video screen shows an arrow the direction of motion of which was to be 'influenced' by the participant, while being driven by true random events.

Random Event Generator

The apparatus featured a new hardware random number generator developed by the author. The source of randomness was based on the thermal noise of two electrical resistors in a differential and shielded configuration that minimized coupling of environmental fluctuations to the noise currents of the resistors. Binary integer numbers of 16-bit lengths (called random *Words*) were obtained by 16 subsequent analog-to-digital conversions of the noise current with 10-bit resolution. Each

of these 16 conversions produced one bit by using only bit 7 of each sample, to be used as one bit of the 16-bit–long Word. To validate the quality of the random Words, they were scrutinized with Marsaglia's 'die-hard' suite of tests (Marsaglia, 1995). No suspicious deviation from randomness was found.

To generate random events for the purpose of the experiment, a new random Word would be drawn when required and compared with the previously drawn random Word. If the new Word was larger than the former, a logical '1' was defined as outcome. If the new Word was smaller than the former, a '0' was defined. The procedure would be repeated in the unlikely event that the Words would be equal. This procedure is similar to a 1-step Markov chain and is the procedure that was used for the experiments described in von Lucadou (2006) and Walach et al. (2020). (Those experiments used single samples of noise of a Zener diode as inputs to the Markov chain.) We call the resulting bits 'Markov bits' or 'random events'.

Two Types of Random Events

For about half of the participants of the experiment, the above procedure was used to generate Markov bits in real time, at the time they were needed to progress the experiment. We call these bits RT-bits (Real Time). For the other half, the above procedure was modified in two ways: First, the random Words from the RNG were modified with an XOR operation with random (16-bit–long) Words from a pseudo-RNG algorithm (Mersenne Twister, Matsumoto & Nishimura, 1998), which was seeded with independently drawn random Words at the start of the experiment. Second, the full sequence of Markov bits was generated (using the XOR modified random Words) at the start of the experiment and then stored in the memory of the control computer. Data were read from this sequence when they were needed to progress the experiment at later times, typically over a period of 15–30 minutes after their generation. We call bits generated in this way XPR-bits (XOR'd and Pre-Recorded).

The split in these two types of random events was introduced to possibly test any result against these seemingly different sources of randomness. The XOR operation with a pseudo-RNG stream would

test whether effects are robust against different complexity levels of the RNG, while the pre-recording aspect would test if correlations work 'backwards in time', also referred to as retrocausation. Work by Schmidt and others has mostly led to the hypothesis that neither of these modifications would affect results (Schmidt, 1976, 1987).

The analysis for Experiments 1 and 2 as defined in the pre-registered blind analysis protocols did not make use of the distinction between the two RNG types, but the split was used in a secondary analysis, which was also performed in a blind, but not publicly pre-registered, way.

Experimental Sessions

The sequence and tasks of the experimental sessions were very similar to the experiments as reported by von Lucadou (2006) and Walach et al. (2020), but the apparatus was novel, as reported above.

For each experimental session, a participant was first instructed about the general goals of the study, with the opportunity to ask questions. The study had been approved by the ethics committee of the Max Planck Society in Germany, and each participant signed a consent form allowing the anonymous use of their data.

In a next step, each participant was asked to fill out a 2-page questionnaire, comprising 50 questions to be answered on a 5-point Likert scale. After this was completed, the participant was guided to the experimental apparatus located in a separate room on a desk in the given localities.

The participants were then asked to press a button to start the experiment. Upon this button press, the control computer would decide randomly (using the comparison of two random words) whether to use RT-bits or XPR-bits for this participant. The participants did not know of the two different bit-generation modalities, and the experimenter (the author) did not know which bit type was determined for each participant until removal of the blind condition.

A test run was then performed in the presence of the author (who was the sole experimenter for all participants), with the author explaining the conducting of the experiment on the hardware device. After this procedure, each participant was left alone in the room to

perform the main experiment in their own time.

The participant had the task of trying to 'influence' the displayed arrow (see Figure 1) to move more in the direction that it was pointing to, either to the right-hand or to left-hand side, or to keep it in the middle of the display, when it was pointing down. A typical experimental session consisted of 9 'runs' for each participant. For each run the participant was asked to use the left and right hand to push a button with either hand, respectively (there was a button for the left hand and a button for the right hand). The possibility of pushing both buttons at the same time was left open and not deliberately mentioned. Each participant then had the task of pressing the buttons at a time of their choice with each button push triggering the generation of an RT-bit at that time, or the reading of an XPR-bit from memory. The obtained bit determined the direction of motion of an arrow in the display (right or left) by one step of fixed size. Each button push was accompanied by a 'cheering' sound when the arrow moved in the intended (intention according to the instruction given) direction (a hit), and by a less pleasant sound when it moved in the opposite direction (a miss). When a new record position of the arrow to the right or left was achieved within a run (with a minimum of 3 steps to either side), a longer 'cheering' sound from a cheering group of people was played back, intended as a particular reward. The auditory feedback was novel in this experiment, with the intent to strengthen the feedback experience.

The condition of the arrow to point right, down, or left was given in each run, thus setting the nominal intention of the participant deliberately for each run. Each of the three conditions (right, middle, left) occurred 3 times, for a total of 9 runs. A run would be finished after 80 button presses and a new run would be started by the participant at will, upon the pressing of a third (yellow) button.

After each run, short feedback was given in the form of a text (as in von Lucadou, 2006) and in the form of the achieved hit scores (for the right and left conditions combined). After the 9 runs a summary feedback was given in form of a text as well as the total hit score and the information that the experiment had now finished.

Data Recording

For each button press (80 per run), data were stored on the non-volatile memory of the control computer, namely:

- which button was pressed (left or right or both)
- the time of the button presses, with a resolution of less than 1 millisecond
- the raw, 16-bit–long Word from the 16 AD samples (for RT-bits) or the 16-bit–long Word from memory (for XPR-bits)

In addition to this, three 16-bit–long Words, and correspondingly three derived bits, were stored as control data that were sampled approximately 1 ms before (1x) and 1 ms and 2 ms after (2x) the experimental sample as described above. These data were not planned to be used in any analysis, but to be used for consistency checks, as reported below.

Pre–Data-Taking Registration

The code running on the computer of the experimental apparatus, the feedback audio files, test random data, as well as the consent form and the questionnaire, have been pre-registered, prior to data-taking, on the open science framework platform and are publicly accessible at https://osf.io/cgf4k.

Participants

Participants were recruited from different pools. A total of 200 participants, the pre-planned number, completed the experiment in the period from December 2017 to May 2019. Of these, 75 were recruited from the general population in the Santa Fe area in New Mexico, USA, and performed the experiment at Mountain Cloud Zen Center in Sante Fe. 48 participants were drawn from a student population of various fields of study in Freiburg im Breisgau in Germany. They performed the experiment at the IGPP institute in Freiburg. A further 56 participants were recruited and tested in Berlin and Hannover in Germany, and the remaining 21 participants were recruited and tested in Oxford and Cardiff in the UK.

The average participant age was 45.6 years with a standard deviation

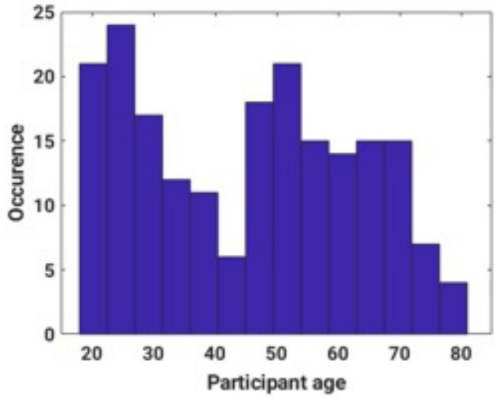


Figure 2. Age distribution across participants.

of 17.5 years. 78 participants reported as male and 122 as female. Figure 2 shows the age distribution of all participants.

Blind Analysis Protocol

Blind analysis is a strict form of a pre-defined analysis and is increasingly used in fields such as medicine and physics (Klein & Roodman, 2005) to prevent bias in the analysis procedure of a dataset. While the social sciences and psychology use blind analysis less, these fields may often benefit from it (MacCoun & Perlmutter, 2015). Potential bias in the data-analysis of parapsychological experiments has been discussed by Bierman et al. (2016) and Wagenmakers et al. (2015), among others.

In blind analysis, not only is the analysis plan pre-registered, but also the complete analysis algorithm, typically a computer program, which is written, fully debugged, and tested before the experimental data are analyzed for the effect under study. This ensures that detailed questions of the analysis that can affect the result (but that may show up only during the performance of the actual analysis) have to be decided beforehand, and any bugs associated with the analysis can be dealt with without introducing biases. In particular, during the 'blind' phase of the analysis development and testing, either artificial data are used, or the real experimental data is used, but in a disguised, i.e., blinded, form. The latter can be achieved conveniently in correlation-type experiments (such as this one) by permuting the association of

psychological to physical variables between different participants. This was chosen for the development of the blind analysis codes for this experiment.

The analysis for this experiment had been specified and tested during the data acquisition phase. In particular the data had not been looked at or analyzed in any way before the unblinding, in agreement with the blind analysis protocol. The analysis of the experiment had been implemented in software (Matlab) as outlined below. The analysis code, as well as all the experimental data, have been pre-registered and are accessible at https://osf.io/xwhn6 for Experiment 1 and at https://osf.io/cj8kd for Experiment 2.

For Experiment 1, the data-analysis procedure closely follows the way the data was analyzed for the latest experiments described in von Lucadou (2006), except for the evaluation of statistical significance of the matrix of correlation factors (which was performed as outlined below). The choice of variables resembles the choice of the experiment reported in Walach et al. (2020), with the exception that one of the psychological and physical variables each was replaced with new ones, as indicated below.

From the data recorded during the experiment (see above), the following five psychological and five physical variables were computed for each run:

Psychological variables:
- Number of left button presses
- Number of both button presses (simultaneous left and right)
- Number of times button (left or right) changed (this is a new variable not used before)
- Mean time between button presses
- Standard deviation of time between button presses

Physical variables:
- Number of hits (arrow moved in the intended direction). For the middle intention runs this was the negative number of steps away from the middle.
- Cumulative number of steps away from target
- Auto-correlation
- Number of cheer sounds (this is a new variable not used before)
- Standard deviation of the 80 raw random generator numbers

The 5 psychological and physical variables from the nine runs yielded 45 psychological and 45 physical variables that were correlated against each other to yield 45 x 45 = 2,025 correlation factors. Each correlation factor was calculated across all participants. As mentioned above, for the main result of this study, only those correlations were considered that were based on time-forward correlations, i.e., only correlating psychological variables with physical variables from a later run. This resulted in 900 correlation factors remaining. While von Lucadou prefers to use all correlation factors, this author prefers the set reduced to time-forward correlations (i.e., psychological variables obtained before physical ones), to principally exclude the possibility of feedback-induced causal correlations as discussed above.

After the matrix elements (the correlation factors) were obtained, a single test statistic was calculated for the matrix, combining all individual correlation factors. For the analysis described here, the absolute values of all correlation factors in the matrix were cubed and then the mean value of these cubed factors was computed. This way of analyzing the data is different from the method used by von Lucadou (1986, 1991, 2006) and Walach et al. (2020): They used the number of 'significant' correlations in the matrix as the test statistic. That method has the potential disadvantage, though, that not all matrix elements contribute to the result. Analysis of existing matrix experiments with both test statistics (performed by this author) show that the mean sum of absolute correlation factors cubed seems to be at least 'as good' as the alternative used by von Lucadou, i.e., yields results that are at least as significant. This was tested on the data of the experiment reported in Walach et al. (2020). A similar test statistic has been used by Jolij and Bierman (2019), using the mean of squared correlation factors.

After determining the test statistic, in a second step the statistical significance of the obtained value was evaluated. This was done by empirically estimating the statistical background distribution (i.e., the expected distribution of results from an ensemble of many random representations of the experiment) using permutations of the psychological variables of participants against the physical variables of other participants. The test statistic for the unpermuted data (the main experimental result) was then compared to the distribution of test statistics from the permuted data. A *p*-value was calculated by dividing

the number of higher test statistics (higher correlations) by the total number of test statistics obtained for the background. A one-sided hypothesis was used that the experimental data without permutations would show more and/or stronger correlations than most test statistics of the background distribution. The background distribution can also be simulated using artificial data as an alternative method. If both methods agree in their result, this can be taken as a strong argument for the validity of the estimated background, as pointed out by Grote (2017).

RESULTS

Experiment 1

The above pre-registered analysis (Experiment 1) was unblinded live during a presentation at the PA convention in Paris on July 6, 2019.

Figure 3 shows the main result against the background distribution that has been obtained by multiple permutations of the experimental dataset. The figure of merit falls well within the background distribution with $p = 0.76$. The three control datasets obtained shortly

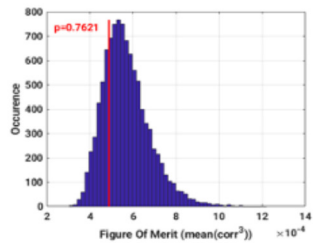


Figure 3. The main result obtained during the 'opening of the box event' at the 2019 PA convention. The graph shows the statistical background distribution obtained with 10,000 permutations of psychological vs. physical data (blue columns). The *x*-axis denotes the mean of all absolute values of cubed correlation factors in the matrix. The *y*-axis denotes the number of occurrences within the 10,000 permutations. The red vertical line shows the unpermuted experimental data. It falls well within the background distribution with a statistical value with a one-sided *p*-value of $p = .76$.

before and after the experimental data (given in this order) also fall within the background distribution with p-values of $p = 0.22$, $p = 0.74$, and $p = 0.08$, respectively (not shown in the graph).

Figure 4 shows the correlation matrices for one of the control datasets (top graph) and for the main experimental data (bottom graph). Notably, there seem to be more correlations close to the diagonal in

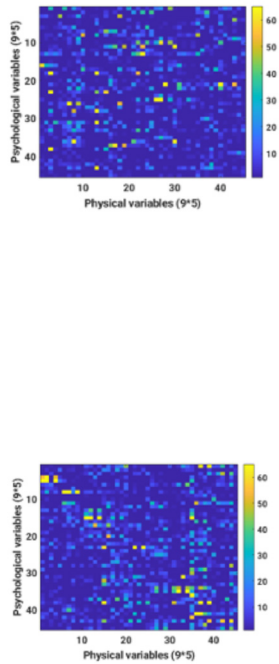


Figure 4. Correlation matrix for a control condition (top graph) and for the experimental results (bottom graph). The color code denotes the cubed absolute correlation factors (times 10,000 in units of the color code scales to the right of the graphs). Higher correlations can be observed close to the diagonal of the experimental matrix on the bottom graph. These are very likely causal correlations, which in any case had been excluded from the preplanned main statistical analysis.

the experimental data matrix on the bottom graph. These are very likely due to causal correlations and are excluded from the main statistical analysis, which uses only the upper right part of the matrix.[2]

However, when including the full matrix in the analysis, including the diagonal elements, the figure of merit of the experimental data results in a probability of $p = 0.17$ to have occurred by chance under a null hypothesis. So even when including the potential causal correlations, the result is not significant.

When splitting the main analysis (for the upper matrix) into the two types of random data used, the p-values are $p = 0.5876$ for the real-time random data (RT-bits), and $p = 0.4321$ for the XOR'd and pre-recorded random data (XPR-bits). This result is commented on below.

Experiment 2

The analysis for Experiment 2 (the correlation between questionnaires and psi task) was unblinded in the sole presence of the author on September 15, 2019.

Figure 5 shows the result against the background distribution that has been obtained by multiple permutations of the experimental dataset.

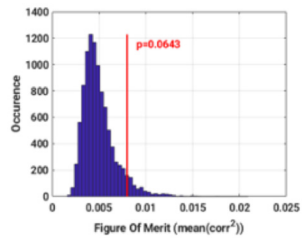


Figure 5. Result of Experiment 2 as obtained during the 'opening of the box'. The graph shows the statistical background distribution obtained with 10,000 permutations of psychological data of the questionnaires (50 variables) against physical data of the psi-task (1 variable). The *x*-axis denotes the mean of all (50) squared correlation factors. The *y*-axis denotes the number of occurrences within the 10,000 permutations. The red line shows the un-permuted experimental data. It results in a one-sided *p*-value of $p = .064$.

The figure of merit falls slightly to the right side of the background distribution with a probability of $p = 0.064$ to have occurred by chance under a null hypothesis. The three control datasets obtained shortly before and after the experimental data fall within the background distribution with p-values of $p = .61$, $p = .53$, and $p = .19$, respectively (not shown in the graph). When splitting this analysis into the two types of random data used, the p-values are $p = .1448$ for the real-time random data (RT-bits), and $p = .1678$ for the XOR'd and pre-recorded random data (XPR-bits). This difference apparently is insignificant.

Post Hoc Analyses

Since one emphasis of this study was to use a blind analysis protocol, no particular post hoc analysis was planned. However, blind analysis does not exclude post hoc analysis in principle, which can range from consistency checks to exploratory analysis in search for novel effects in the data. Blind analysis just helps to draw a very clear line of distinction between preplanned and post hoc analyses.

Triggered by the first of the additional observations as reported below, it was decided to calculate the simple psi-task related outcome of how successful the 200 participants were in 'shifting' the arrow in the display in the instructed left or right direction. It was found that the participants were 'successful' in the intended direction (hits) with a surplus of 138 bits out of $N = 96{,}000$ trials (200 x 6 x 80). This corresponds to a probability of $p = 0.064$ (one-sided) to have occurred by chance under a null hypothesis. Note that the standard deviation (SD) for the underlying Markov chain is $SD = \mathrm{sqrt}(N/12)$ and not the usual $SD = \mathrm{sqrt}(N/4)$ as for independent random bits (see von Lucadou, 1986). Also note that the numerical value for this probability (.064) is the same as the above reported for the correlation analysis. This is pure coincidence, since the underlying degrees of freedom are completely independent in both cases (!).

The split analysis for the two types of random data (for the above analysis) yielded $p = .111$ for the real-time data and $p = .107$ for the XOR'd and pre-recorded data. Apparently, both of these contributed about equally to the combined result.

Another post hoc analysis was to run the analysis for the second experiment, also using the absolute value of correlation factor cubed,

instead of squared. The result was exactly the same, i.e., a *p*-value of $p = .064$. This nicely demonstrates the robustness of this figure of merit (at least for these data).

Further, the 50 psychological variables of the questionnaire were also correlated with the 5*9 physical variables as used for the analysis of the main experiment. This more resembles the way the data was analyzed for the early CMM experiments, as by von Lucadou (1986, 1991). The result was not significant with a *p*-value of $p = .647$.

SOME ADDITIONAL OBSERVATIONS: TRICKSTER AT WORK?

I would like to report here three occurrences that happened around the execution of the experiment and the testing and execution of the analysis, that I found quite remarkable. I would not classify these as 'post hoc' analyses, but rather as observations that occurred, without deliberately looking for them.

The first occurrence was the experimental result of an 8-year-old boy, who performed the experiment as the only person other than the regular cohort of 200 participants. Since the experiment required the filling out of a questionnaire and the signing of a consent form, it was only suitable for adults. However, during my presence at the house of his parents, the boy insisted on performing the experiment. So I let him have his way, while deciding that his data would not enter the analysis. At the end of his session, the boy had reached the most extreme result of the main psi task (the number of hits), compared with all 200 other participants. His total score was –19 with a two-sided probability of this or a more extreme result to have occurred by chance (under a null hypothesis) of $p = .0038$. Obviously, if 200 participants do such an experiment, the occurrence of one such result is not surprising at all. The surprise lies in the fact that this result was obtained by the only non-regular performer of the experiment, who happened to be a child.

The second occurrence was related to the differential analysis, comparing the experimental results for the two cohorts of data using either the real-time RNG (RT-bits) data or the XOR'd and prerecorded RNG data (XPR-bits). This code for this analysis was tested using artificial pseudo-random data generated with Matlab. The first three tests of this analysis code yielded $p = .06$, $p = .95$, and $p = .0003$ for the

results (or more extreme ones) to have occurred by chance. As a sort of memo, Figure 6 shows the last result as it was first obtained. The 'p = 0' result of this test came from the limited number of permutations of n = 1,000 used for estimating the statistical background of the test data. In a subsequent run using n = 10,000 permutations for the same test data, the more accurate estimate of p = .0003 as reported above was obtained. The combined p-value for the three extreme results is of the order $p \sim .0001$. Further tests with new artificial data converged to a uniform distribution of p-values as expected. So while this was a test run for the analysis code, subsequently nothing was found wrong with the code. Given this expected performance of the analysis code, I found the initial results quite surprising. Similar surprises had been encountered in other work reported by Grote (2017).

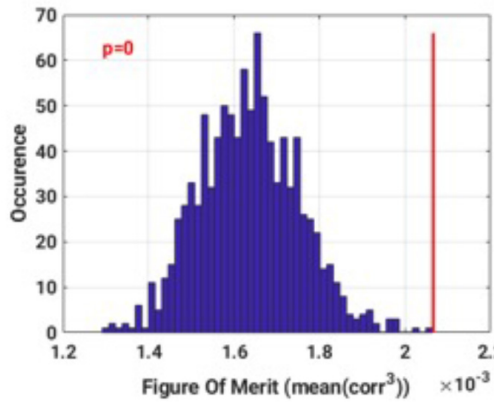
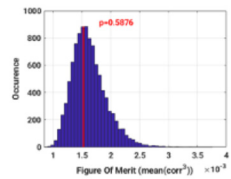


Figure 6. Result of third test run for the split RNG analysis. The author was struck by the extreme result, with subsequent results converging to the expected uniform distribution.

The third occurrence was related to finally performing the differential analysis on the unpermuted data, once the testing of the code for the split RNG analysis had been completed. Figure 7 shows the two histograms of background distribution and the results for the two random event groups. After I had first produced the graph on the top, I thought that the composition of digits of the obtained p-value of p = .5876 looked 'funny', like a sequence of numbers after the decimal

point, though shifted by one digit. While briefly wondering about this, I produced the graph on the bottom next, which, to my surprise, resulted in a *p*-value of $p = .4321$. Note that these two *p*-values are completely independent of each other, since they represent the data of the main experiment, split into two independent groups, according to which type of random event was used.

DISCUSSION



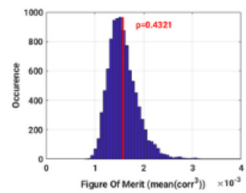


Figure 7. Result of the main experiment as split for the two types of RNG data used: Using the real-time data (top) and the XOR'd and prerecorded data (bottom). The author was struck by the 'funny' numbers of the estimated probabilities.

Each reader may draw their own conclusions, but the experiments and their results reported here may merit discussion of several topics: 1) The conceptual replication of a CMM experiment using a blind analysis protocol; 2) The conceptual replication of a CMM-similar experiment correlating questionnaires with a single psi task, also using a blind analysis protocol; 3) A post hoc finding of marginal significance of the main psi task and its relation to the replication problem and the idea of the CMM experiment; 4) Trickster-like properties of the experimental outcomes and incidental observations; and 5) some thoughts about future research.

1) The conceptual replication of the CMM-type experiment of the type performed before (von Lucadou, 2006; Walach et al., 2020) (Experiment 1 as reported above) has yielded no evidence of anomalous correlations. While the methodology of using blind analysis was slightly stricter than the methodology in von Lucadou's and Walach et al.'s experiments, I do not believe that this was a decisive factor in this outcome. If we do not question the positive results reported by von Lucadou (1986, 1991, 2006) and Walach et al. (2020), I would interpret the null result of the experiment reported in this study as either the result of a decline of effects in repeated parapsychology experiments, or as a sign that I am not a very psi-conductive experimenter (at least for this experiment). The latter would pertain to the hypothesis that experimenters may have different levels of 'psi-conductivity', as has been observed by different researchers. Both of these interpretations touch upon profound problems in parapsychological research.

If experimenter-psi effects are taken into account (see Palmer & Millar, 2015, for a more recent overview), then in addition one may also consider the audience that observed the unblinding of the main experiment during the presentation at the PA convention in Paris. With some humor I would say I am a bit disappointed by the psi performance of this particular, select audience in 'influencing' the outcome of the main experiment. In a snap poll, about half of the audience expressed the opinion that the result of the study was not yet determined at the moment before the unblinding of the analysis, leaving room for the audience to 'influence' the imminent outcome. In their defense one may argue that the total person-hours of the audience are significantly fewer (~100) than the person hours the author invested

in this study (~600). This could provide a simple numerical measure of a psi effort, while other concepts such as 'involvement' and 'motivation' are harder to quantify.

While the experimenter psi hypothesis is often neglected in parapsychological research, perhaps to no small degree because it renders research even more difficult in terms of reproducibility and other factors, a correlation experiment seems to be particularly prone to experimenter-psi, if it exists. This is because in a correlation experiment, no single individual participant can be 'successful' on his or her own. The result of the experiment is always one (or many) correlation factor(s) obtained across an *ensemble* of participants. For a single participant the result would simply not be defined. The group of participants can generate the effect under study only as an ensemble. In this context, it's completely unclear what the role of a 'gifted subject' may be. One can speculate that if experimenter-psi exists (and why would it not under a psi hypothesis?), then a correlation-type experiment is particularly prone to experimenter-psi.

2) The second experiment in this study (Experiment 2), a conceptual replication of the work reported by Jolij and Bierman (2019), yielded marginal evidence ($p = .064$) of anomalous connectivity—of the same order of magnitude as found in Jolij and Bierman. It is worth noting that this way of performing a CMM-like experiment is closer to the early experiments of von Lucadou (1986, 1991) where questionnaires were also used. I would not claim here that a new experimental paradigm has been found, but rather make note that this is only the first replication of the work by Jolij and Bierman, and effects may decay in the future. Taking the marginal evidence seriously, another interpretation would be that of a Trickster-like result, where the effect went back to where it was found in the past, i.e., in the correlation studies using questionnaires as reported by von Lucadou (1986, 1991). Note though that only one physical variable was used in the planned analysis presented here, and the correlation with all physical variables was found not to be significant (as reported above).

If one is inclined to interpret the result of $p = .064$ as an anomaly, it is interesting to note that no difference between the two types of random source has been found, which implies that the result was obtained including some level of 'retro-pk'-like phenomenon (see

for example Schmidt, 1976) and was also independent of the type or complexity of random event generator (Schmidt, 1987).

3) The posthoc result of $p = .064$ (the same number as above, but a different result!) for the main psi task of 'influencing' the left–right direction of the observed arrow by the participants may be a chance result, of course. It is remarkable though that such an effect showed up in a place where it was not expected, since the whole CMM idea was developed around the notion that psi would not act in a 'signal-like' fashion such as to 'influence' the outcome of RNGs in a particular direction. If one interprets the observed $p = .064$ deviation as the hint of an anomaly, then the whole history has come full circle: An effect in a simpler RNG-PK 'influence' type of experiment was observed, but not in the more complex CMM-type analysis. Again, this has more of a Trickster quality than anything else. The CMM method was an ingenious idea to reliably observe anomalous connections in data by way of multiple correlations. However, we may be facing Trickster qualities that will always be a bit *more* ingenious. This is a conclusion that certainly would concur with J. P. Hansen's analysis of parapsychological research (Hansen, 2001), and that has also been exposed by Kennedy (Kennedy, 2003).

4) Further to the Trickster-like observation in 3), the three reported incidental observations can be seen as pure chance and would probably be dismissed and not be reported by most researchers, certainly in mainstream academia. In the context of a psi experiment, to me they had a very special quality, and I am more inclined to interpret them as another Trickster manifestation: While psi effects have been sought in a carefully planned and executed experiment, they have been found at the edges of this endeavor, in unexpected places. In addition to its Trickster quality, this sort of 'displacement' effect has also been described as the 'capricious' or 'unsustainable' nature of psi (see Kennedy, 2003, and references therein).

5) My main conclusion and suspicion is that the CMM idea will not escape the replication problem in parapsychology. Another possible interpretation could come from dominant psi-experimenter effects. Under a psi hypothesis, psi-experimenter effects need to be taken seriously. This has been pointed out by many (see again Palmer & Millar, 2015, p. 293, for an overview), but it still is not a theme frequently

adhered to across the board. In addition to psi-experimenter effects, the Trickster theme (which obviously would also play into psi-experimenter effects) may be more ubiquitous than existing scientific literature would make us believe.

The experiments reported here have spanned methodology from the extremely controlled (blind analysis) to the anecdotal (subjectively 'funny' or surprising incidences), and I believe the full breadth of these methodologies is needed to shed light on psi in the experimental domain. Obviously, it would make not much sense now to propose an experiment where we look for a Trickster effect, such as for odd statistical results when testing analysis code. This would lead to a regression ad infinitum. In a sense this is what the CMM idea was trying. We may as well continue to do so, but I believe it will be important to pay attention to the more subjective qualities of such experiments as well. I strongly think that experimental parapsychology research should be rigorous (to not fool ourselves) and descriptive (in a subjective experience sense) at the same time. A planned experiment then also resembles something of a single case study in the field. This avenue has been less explored, but the recent work by Herb Mertz is an excellent example in this category (2020).

NOTES

[1] The experiments published by Walter von Lucadou (von Lucadou 1986, 1991, 2006) had not taken into account internal correlations between psychological variables and thus overestimated the statistical significance of the results. The method proposed and applied by this author, to use simulations or appropriate permutations to estimate the statistical significance, was deemed 'conservative' by other researchers (Walach et al., 2020), citing work by Calude and Longo (2017). This author thinks citing Calude and Longo in this context misses the point. The fact that (nearly) any correlations can be found in a (nearly) infinite amount of data is unrelated to the question of statistical significance.

[2] When observing the correlations of psychological and physical variables from the same run (the 9 times 5 x 5 pixels on the diagonal of the matrix), the physical variables tending to showing higher correlations are 1, 2, and 4, predominantly with psychological vari-

ables 4 and 5. Physical variables 1, 2, and 4 are related to the 'success' of the participant, and psychological variables 4 and 5 are the mean and variance of the times to press buttons. A causal explanation of increased correlations may well be the longer time and variance participants may have used for pressing buttons when being 'successful' and hearing more cheer sounds. (The cheering sounds last longer than just the 'success in intended direction' sound.)

ACKNOWLEDGMENTS

I thank the BIAL foundation for support of this work under grant number 161/19. I also thank Eberhard Bauer, Bettina Grote, Karolina Kirmse, and Nikolaus von Stillfried for valuable comments on the manuscript and Walter von Lucadou for his enthusiasm and tireless discussions on the topic. I thank the Max Planck Society for endorsing this work via their ethics committee. No other resources of the Max Planck Society have been used for this study.

REFERENCES

Bierman, D. J., Spottiswoode, J. P., & Bijl, A. (2016). Testing for questionable research practices in a meta-analysis: An example from experimental parapsychology. *PLOS One*, *11*(5), e0153049. https://doi.org/10.1371/journal.pone.0153049

Calude, C. S., & Longo, G. (2017). The deluge of spurious correlations in big data. *Foundations of Science, 22*(3), 595–612.

Filk, T., & Römer, H. (2011). Generalized quantum theory: Overview and latest developments. *Axiomathes*, *21*, 211–230. https://arxiv.org/abs/1202.1659 https://doi.org/10.1007/s10516-010-9136-6

Grote, H. (2015). A correlation study between human intention and the output of a binary random event generator. *Journal of Scientific Exploration*, *29*(2), 265–290.

Grote, H. (2017). Multiple-analysis correlation study between human psychological variables and binary random events. *Journal of Scientific Exploration*, *31*(2), 231–254.

Hansen, G. P. (2001). *The trickster and the paranormal*. Xlibris. ISBN 1-4010-0082-7.

Jolij, J., & Bierman, D. (2019). Two attempted retro-priming replications show theory-relevant anomalous connectivity. *Journal of Scientific Exploration*, *33*(1), 43–60.

Kennedy, J. E. (2003). The capricious, actively evasive, unsustainable nature of psi: A summary and hypotheses. *Journal of Parapsychology, 67*(1), 53–74.

Klein, J. R., & Roodman, A. (2005). Blind analysis in nuclear and particle physics.

Annual Review of Nuclear and Particle Science, *55*, 141–163. https://doi.org/10.1146/annurev.nucl.55.090704.151521

MacCoun, R., & Perlmutter, S. (2015). Blind analysis: Hide results to seek the truth. *Nature, 526*(7572), 187–189.

Marsaglia, G. (1995). The Marsaglia random number CDROM including the Diehard battery of tests of randomness. https://web.archive.org/web/20160125103112/http://stat.fsu.edu/pub/diehard/

Matsumoto, M., & Nishimura, T. (1998). Mersenne twister: A 623-dimensionally equidistributed uniform pseudo-random number generator. *ACM Transactions on Modeling and Computer Simulation*, *8*(1), 3–30. https://doi.org/10.1145/272991.272995

Mertz, H. (2020). *The selection effect: How consciousness shapes reality*. Penn Wolcott Press. ISBN 1733508007.

Palmer, J., & Millar, B. (2015). Experimenter effects in parapsychology research. In E. Cardeña, J. Palmer, & D. Marcusson-Clavertz (Eds.), *Parapsychology: A handbook for the 21st century*. Mc Farland.

Schmidt, H. (1976). PK effect on pre-recorded targets. *Journal for the American Society for Psychical Research*, *70*, 267–291.

Schmidt, H. (1987). The strange properties of psychokinesis. *Journal of Scientific Exploration*, *1*(2), 108–118.

von Lucadou, W. (1986). Experimentelle Untersuchungen zur Beeinflussbarkeit von stochastischen quantenphysikalischen Systemen durch den Beobachter. H.-A. Herchen Verlag.

von Lucadou, W. (1991). Locating Psi-bursts: Correlations between psychological characteristics of observers and observed quantum physical fluctuations. In D. L. Delanoy (Ed.), *The Parapsychological Association 34th Annual Convention Proceedings of Presented Papers* (pp. 265–281).

von Lucadou, W. (1995). The model of pragmatic information (MPI). *European Journal of Parapsychology, 11*, 58–75.

von Lucadou, W. (2006). Self-organization of temporal structures—A possible solution for the intervention problem. In D. P. Sheehan (Ed.), Frontiers of time. Retrocausation—Experiment and theory. *AIP Conference Proceedings*, *863*, 293–315 (San Diego, CA, June 20–22). https://doi.org/10.1063/1.2388760

Wagenmakers, E.-J., Wetzels, R., Borsboom, D., Kievit, R., & van der Maas, H. L. J. (2015). A skeptical eye on psi. In E. May & S. Marwaha (Eds.). *Extrasensory perception: Support, skepticism, and science* (pp. 153–176). Praeger.

Walach, H., Horan, M., Hinterberger, T., & von Lucadou, W. (2020). Evidence for anomalistic correlations between human behavior and a random event generator: Result of an independent replication of a micro-PK experiment. *Psychology of Consciousness: Theory, Research, and Practice, 7(2), 173–188.* https://doi.org/10.1037/cns0000199

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 311–344, 2021 0892-3310/21

RESEARCH ARTICLE

The Effects of Meditation and Visualization on the Direct Mental Influence of Random Event Generators

Tayzia Collesso
Department of Psychology*, King's University College, Western University, Canada

Maria Forrester
Faculty of Science*, Western University, Canada

Imants Barušs
Department of Psychology, King's University College, Western University, Canada
baruss@uwo.ca

Submitted July 3, 2020; Accepted January 5, 2021; Published June 15, 2021

https://10.31275/20211891

*Tayzia Collesso is now at Faculty of Law, Western University; Maria Forrester is now at Mariposa Wellness Canada.

Abstract—Meditation and visualization exercises have been found to alter an individual's mood and perception, and it is hypothesized that these techniques will enhance one's ability to anomalously influence the function of a random event generator (REG) with the mind. This study comprises a control experiment and a second experiment with the administration of meditation and visualization exercises. There was no support for a significant deviation of the REG in the direction of the participants' volition in Experiment 1 ($t(29) = -1.26$, $p = .22$, two-tailed), but results revealed a significant deviation in the intended direction in Experiment 2 ($t(29) = 2.66$, $p = .01$, two-tailed). Moreover, comparisons between cumulative deviations across both samples were found to be statistically significant, suggesting that the use of meditation and visualization exercises might promote significant deviations ($t(58) = -2.69$, $p = .009$, two-tailed). These analyses suggest that the use of meditation and visualization techniques in experiments that study direct mental influence may be beneficial for finding anomalous effects.

Keywords: meditation, visualization, random event generator, direct mental influence

> *Discovery commences with the awareness of anomaly . . . with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science. It then continues with a more or less extended exploration of the area of anomaly. And it closes only when the paradigm theory has been adjusted so that the anomalous has become the expected.* (Kuhn, 1970, pp. 52–53)

INTRODUCTION

Psychokinesis (PK) is the apparent direct manipulation of animate or inanimate objects with the mind. It is a psi phenomenon, or a function of the mind that is anomalous in nature, as it cannot be explained by conventional science. There is a considerable amount of evidence that supports the occurrence of direct mental influence. However, the extent to which a person believes that physical manifestation can be affected directly by the mind depends on her boggle threshold, or what she is willing to accept as real (Barušs & Mossbridge, 2017). It is important to note that our understanding of consciousness remains limited, and this arguably will persist if the scientific community continues to disregard the substantial evidence for anomalous phenomena and fails to give it sufficient consideration.

The Princeton Engineering Anomalies Research (PEAR) laboratory was developed to experimentally monitor direct mental influence within a controlled setting with an array of electronic devices. Effects on electronic devices are considered to be micro-PK. However, experiments also were conducted involving people-sized events. For example, a 6- by 10-foot random mechanical cascade was built to produce random events as 9,000 polystyrene balls were released into a transparent box filled with 330 perpendicular pegs; the polystyrene balls collected in the 19 slots at the base of the box so as to form a normal distribution. To test for the occurrence of direct mental influence, subjects were asked to attempt to mentally deviate the normal distribution to the left or to the right. A right-going intention run, a left-going intention run, and a baseline run were combined to form a session, and a series was composed of 10 or 20 sessions. The difference between left-going intention and right-going intention was statistically significant over 87 series and there was a probability of less than 5 in 100,000 that results occurred by chance (Dunne et al., 1988; Dunne & Jahn, 1992; Barušs & Mossbridge, 2017).

The Random Event Generator

The use of electronic devices can be traced back to the 1970s, when Helmut Schmidt devised an electronic random event generator (REG) based on radioactive decay as a mechanism by which to study PK (Schmidt, 1971; Braud, 2003). There has been considerable REG research since that time. A comprehensive review can be found in Chapter 6 of *Transcendent Mind* by Imants Barušs and Julia Mossbridge (2017; see also Walach et al., 2020; Mertz, 2020). The first experiment reported in this paper mimicked the protocol developed in the PEAR lab. The REG consisted of an electronic device that produced a binary signal based on the reverse current across a diode. The output is set up in such a way that it can be thought of as a sequence of pluses and minuses with an equal chance of observing either a plus or a minus. The expected mean is 100 when the REG is set to 200 pulses per trial. A number of trials form a run, and a number of runs form a series. To test for the occurrence of direct mental influence, participants are asked to attempt to mentally deviate the randomly generated cumulative deviation line displayed on a computer screen away from the expected mean for a number of runs. The participant is asked to select a high or low intention for each independent run, and successful deviations occur when a participant's intention matches the output of the randomly generated line. Subsequently, the difference between the average scores of high-intention runs and low-intention runs, within a series, can be used to test for a statistically significant effect. Meta-analysis of PEAR laboratory experiments using the electronic REG over a period of 12 years, with 91 individual operators, found significant deviations for high–low differences in the intended direction ($z = 3.81$, $p = 6.99 \times 10^{-5}$; Jahn et al., 1997). It is important to note that such anomalous effects are not necessarily caused by direct mental intention, even though we loosely talk about these experiments in that manner, but, in cases where participants have sufficient freedom to select or initiate runs, it could also be due to participants' precognitive abilities to anticipate the output from the REG.

Psychological Parameters Affecting Direct Mental Influence

Jim Carpenter has theorized that the capability to affect physical manifestation with the mind is a non-conscious ability, lying at the boundary of one's ordinary mental capacities and explicit awareness and intention. The premise is that psi phenomena lie at the primary stage of experience and that all experience, intention, and action emerge from psi processes. Our non-conscious intentions are deemed to be primary as these intentions function to help our psyche select and understand the nature of our experiences, and to initiate a response to those experiences (Carpenter, 2004). Correspondingly, in emotional presentiment studies, certain networks of meaning and affect have been shown to become aroused prior to sensory stimulation, indicating that parts of our psyche appear to perceive a stimulus before it is present, hence, regarding such perception as "first sight" (Carpenter, 2004). It should be noted that the presentiment studies look at ESP and not PK specifically; it may be plausible, however, that PK functions in a similar manner to ESP (Carpenter, 2004). As psi processes are conceived to function in a parallel manner to conscious processes, Jim Carpenter (2004) has posited that direct mental influence in the intended direction may be possible for individuals who can synchronize non-conscious intentions with conscious intentions.

The mind apparently is able to appraise extrasensory information, but tuning into relevant material, as well as maintaining intention stability and turning away from irrelevant material, are important for producing significant REG deviations. Conflicted intentions, on the other hand, are believed to produce smaller deviations from chance (Carpenter, 2004). If individuals are able to tune in to an experience and accept the flow of events, it is believed that direct mental influence in the intended direction will be facilitated. Contrarily, if an individual is resistant to the flow of events, perhaps due to an underlying factor, such as frustration or fear, effects in the unintended direction appear to be produced (Carpenter, 2004). In an ESP study conducted by Carpenter (1971), subjects were asked to perform an extrasensory perception guessing task. Half of the targets were placed with emotionally evoking material while the other half were placed with blank cards. The subjects who were low in anxiety were able to accurately guess the targets that

were placed with arousing material, indicating that these subjects may have had an implicit interest in the emotionally evoking material and, perhaps, were able to tune into its relevancy. The subjects who were high in anxiety, however, psi-missed on the emotionally evoking material and did not choose the targets with arousing material, almost as if these subjects' non-conscious intentions were to avoid a potentially dangerous event (Carpenter, 1971). If PK processes are analogous to ESP, this suggests that a certain level of openness and unattachment may be necessary to tune into relevant material. In other words, if an individual places too much emphasis on correctly completing the task or performs an excessive amount of cognitive analysis, an effect in the unintended direction may be observed.

While negative emotions tend to correspond with deviations of the REG in the unintended direction (Carpenter, 2004), there is research that supports that emotions, such as enthusiasm and feelings of connectedness with the machine, have been related to successful deviations. The case of Susan Padfield is an example of research concerning emotions of connectedness (Barušs & Mossbridge, 2017). Susan Padfield was able to influence the movement of a light mobile in laboratory settings for multiple observers, and she indicated that she felt as though she had merged with the mobile on a mental level and was able to create its future state (Padfield, 1980). Perhaps, the ability to maintain intentional stability is facilitated by positive emotions. Similarly, Jahn et al. (1997) found that there was a commonality to be found in PEAR lab experiments: The most successful operators tended to describe the devices in anthropomorphic terms, describing the machine as if having a bond with it or empathizing with it. Certain individuals may also be more gifted or motivated to engage psi abilities as a result of doing creative work, and this may be why individuals who were high in creativity were also more likely to produce significant evidence for psi in Ganzfeld telepathy experiments (Barušs & Mossbridge, 2017). Furthermore, the fact that creativity may have an impact on psi processes coincides with the belief that maintaining a certain level of openness may promote direct mental influence in the intended direction.

Direct Mental Influence Without Intent

In the same way that the emotions and cognitions of subjects have an effect in direct mental influence experiments, it is also important to consider the emotions of others, and a possible experimenter effect. In fact, some studies have shown that the REG appeared to deviate in accordance with the emotional states of participants who were focusing on alternative tasks (Broderick & Goertzel, 2014). The FieldREG is a way of conceptualizing the output from the random event generator as a single bit-stream to test for PK without directed conscious intention. One way of thinking about such studies is to imagine that the FieldREG can be influenced by a consciousness field that interacting participants may generate (Nelson et al., 1996). Consistent with such ideas, Nelson et al. (1998) discovered that there were significant FieldREG deviations that correlated with the emotional engagement and enthusiasm generated by participants while visiting several venues, including ancient Egyptian sites and the New York City Opera. Intellectual engagement, on the other hand, did not produce any significant effects. As a second example, Jahn et al. (2006) studied the effects of a Japanese healing technique on subjects in human–machine experiments and discovered that the outputs of FieldREG data tended to display mean shifts that deviated from what is expected by chance when there was "a high degree of emotional resonance among the participants" (p. 2). As a third example, Roger Nelson ran a FieldREG during a field trip to watch a sunset across a lake. As the sun set, the participants became silent and directed their attention to the setting sun. If the one-hour segment bracketing the time of the sunset is regarded as a pre-defined dataset, then the striking positive deviation of the FieldREG that was noted during that timeframe had a probability of occurrence of $p = .008$ (Barušs, 2007).

Even though the direction of the deviation cannot be predicted with the FieldREG, it appears that high levels of positive emotions tend to correspond to directional deviations in REG functioning (but see also Varvoglis & McCarthy, 1986). This leads to a question that we hoped to answer: What exactly are the relevant parameters of such positive emotions? In addition, we would like to know whether a participant's nonconscious and incidental influence on FieldREG functioning is

correlated with the results of deliberate influence on REG functioning. In this study we aim to investigate whether individuals who can produce FieldREG deviations are also more likely to produce REG deviations for intentional runs.

Meditation as an Aid

Any discussion of meditation needs to begin with the acknowledgment of just how vast the meditation literature is and how large the range of psychological and physiological states that accompany meditation is (Barušs, 2020). In terms of regulating emotion, Margolin et al. (2011) have noted that regular identification with anxiety creates a barrier to experiencing peace and joy, and some forms of meditation may be used to reduce this anxiety. Meditation may also be used to induce both physical and mental stillness in an altered state of consciousness. Likewise, it has been found to enhance one's self-awareness (Margolin et al., 2011). Silencing excessive mental noise or rational thoughts, as well as heightening one's awareness of a deeper self, may increase an individual's capacity to tune in to relevant information. If meditation is able to reduce the extent to which negative emotions affect our awareness and allow us to align our unconscious intentions with our conscious intentions, then this could be a key for the study of direct mental influence.

Recent literature in neuroscience suggests that meditation practices appear to alter brain chemistry, structure, and function in a more permanent manner as well. Specifically, it was reported that long-term meditation practices have an effect on brain regions that are associated with emotion and attention. For example, meditation has been linked with increased selective attention capacity, which is an enhanced ability to focus on a certain outcome while silencing undesired outcomes. Moreover, mindfulness meditation has been correlated with diminished activity in the amygdala, which is associated with the production of fear and anxiety (Margolin et al., 2011). Both of these effects would appear to benefit direct mental influence in the intended direction.

Some types of meditation and visualization practices draw on the notion that the mind has an untapped potential to create, and this

potential can be brought into awareness so that desired states become reality. Specifically, conscious visualization is believed to have the ability to create thoughts, emotions, and events in one's phenomenal world in accordance with one's ambitions and goals (Margolin et al., 2011). In some forms of meditation, the distinction between subject and object, and the observer and the observed, becomes blurred. Loving-kindness and compassion meditations also are of particular interest here as they generate a consistent emotional tone that is exclusive of other types of affect (Fox et al., 2016). The consistent emotional tone is perhaps generated as participants are asked to project positive emotions toward others or in reference to no subject at all.

If meditation and visualization are able to transform the brain, one's mood, and one's perception, then it is possible that applying these techniques to PK experiments may facilitate direct mental influence in the intended direction. In a series of experiments in which participants were asked to direct their attention toward or away from a two-slit optical device, it was found that those who identified themselves as meditators, without further specification of the type of meditation that they practiced, were better able to influence the device when requested to direct their attention toward the device than those who did not identify themselves as meditators (Radin et al., 2012). One of the strategies in Experiment 2 in this study was to prime feelings of love by leading participants through a guided imagery meditation as one of a number of manipulations that could increase the likelihood of finding a positive REG deviation.

Hypotheses

The purpose of these studies is to contribute to the expanding literature on consciousness by exploring the psychological correlates of direct mental influence and the role that meditation and visualization may have in enhancing anomalous manipulation. Experiment 1 will act as a control sample for Experiment 2, which introduces the meditation and visualization component to the study. The comparison of both samples will make it easier to identify any relevant parameters.

Experiment 1

1. It is hypothesized that there will be a significant deviation in the intended direction.
2. It is hypothesized that trials without directed conscious intention, measured by the REG running in FieldREG mode, will predict subsequent trials completed with intention as measured by the REG in PEAR Classic mode.
3. The Beliefs About Consciousness and Reality Questionnaire (BACARQ) is used for measuring transcendental beliefs. It is hypothesized that individuals with a high composite score on the BACARQ will be more likely to deviate the REG in the intended direction.
4. The Expressions of Spirituality Inventory (ESI) is used for measuring spirituality. It is hypothesized that individuals with a high composite score on the ESI will be more likely to deviate the REG in the intended direction.
5. It is hypothesized that individuals who are in an altered state of consciousness, as indicated by the Phenomenology of Consciousness Inventory (PCI), will be more likely to deviate the REG in the intended direction.
6. It is hypothesized that those who identify with the machine or feel a transcendent unity with it will be more likely to deviate the REG in the intended direction.
7. It is hypothesized that those who think they can alter the machine also will be more likely to deviate the REG in the intended direction.

Experiment 2

1. The meditation and visualization techniques used will aid in promoting successful deviations in that there will be significantly more deviations in the intended direction in comparison with Experiment 1.
2. Individuals who experience feelings of love, as measured by the Phenomenology of Consciousness Inventory, will be more likely to deviate the REG in the intended direction.
3. Individuals scoring high in rationality, as measured by the Phenomenology of Consciousness Inventory, will be less likely to deviate the REG in the intended direction.

GENERAL METHOD

Participants

Participants were volunteers recruited from Western University, King's University College consciousness-related courses, the Psychology 1,000 participant pool, and the community. There was a total of 60 participants for both experiments, with 30 participants in each sample. In Experiment 1, the mean age was 22.9 years (SD = 6.9, age range: 18–55). Eighteen participants were recruited from the participant pool whereas 12 participants were volunteers outside of the participant pool. The mean age for Experiment 2 was 29.1 years (SD = 10.5, age range: 19–69), and the sample consisted primarily of individuals from the community (n = 18). Students currently enrolled in consciousness-related courses and individuals who expressed an interest in the study of consciousness were targeted due to the fact that expectation and beliefs about consciousness are presumed to be important in terms of being receptive to anomalous phenomena and of deviating the REG in the intended direction. Although the participants did not receive monetary compensation, participants from the introductory psychology pool were granted course credit for taking part in the study.

Materials

Desktop Computer. A custom desktop computer, built by Superior Computers and linked to a Sony computer monitor, an ergonomic keyboard, and an ergonomic mouse, was used for running specialized REG software with which study participants interacted.

Random Event Generator (REG). The REG used in this study was an electronic device manufactured by Psyleron that produces random binary events by measuring the reverse current across a diode that is produced by quantum mechanical tunneling. This quantum process produces random sequences of one of two possible outcomes which can be displayed on a computer to which it is attached, in order to determine if the sequence conforms to random alternation. Both FieldREG software and PEAR Classic REG software are loaded on the computer and are used to register input from the REG, as well as display the data on the computer screen in the manner of a cumulative deviation graph (Psyleron, 2009). The FieldREG software is used to

collect data without any intention to move the randomly generated cumulative deviation line up and down, whereas the PEAR Classic REG software is used to collect data with such intention. In the present study we investigated any correlations between cumulative averages for the FieldREG and PEAR Classic REG. Since only relative measures and correlations were used in this study, no control or calibration runs were necessary, nor were any carried out. It should be noted that if direct mental influence does occur, as previous research has indicated, then even control and calibration runs are being influenced by the experimenter and anyone else who becomes aware of such runs.

PseudoREG. The PseudoREG mimics the output of an REG by using the random number generator on a computer rather than on the REG. The PseudoREG, instead of the REG, was inadvertently used with the PEAR Classic REG software in Experiment 1.

Relaxation Meditation Script. A 2- to 3-minute relaxation meditation was used in Experiment 2 to redirect thoughts about external events toward internal occurrences within the body. The primary goal of this relaxation meditation was to promote tension identification as well as tension reduction. It is assumed that the release of tension would encourage the release of other negative emotions, such as frustration, fear, and anxiety, and would also increase awareness. The script can be found in Appendix A.

Visualization Exercise Script. A 3- to 5-minute guided imagery exercise was used following the relaxation meditation in Experiment 2 and the script can be found in Appendix B. The visualization exercise was employed to stimulate imagination and further induce relaxation as well as positive emotions, including promoting feelings of love.

Visualization Suggestions. Prior to interacting with the REG in Experiment 2, participants were introduced to the basic components of the PEAR Classic REG software and were given strategies that were believed to promote deviations in the intended direction. These suggestions can be found in Appendix C. Participants were encouraged to apply visualization techniques and to attach positive qualities to the randomly generated line. Participants were also advised to avoid harboring feelings of frustration when the line deviates in a manner inconsistent with the individual's intended direction.

Environmental Manipulations. In an attempt to produce a more

relaxing, inspiring, and all-around positive environment in Experiment 2, a potted plant was placed on the desk and posters that illustrated woodland imagery, along with other visuals intended to encourage calmness and imaginative thinking, were strategically mounted on the walls. Moreover, the overhead lights of the lab room were switched off for the duration of the experiment, and instead, two desk lamps were used to illuminate the desired areas of the room.

Measures

Demographics and Attitudes Form. This form was given at the beginning of both experiments and contains questions about the participant's age, gender, education, religious views, and frequency of religious practice. It also contains a five-point Likert-type question pertaining to the participant's belief in their ability to alter the functioning of the REG with one being "definitely not" and five being "definitely yes." This form can be found in Appendix D.

Beliefs About Consciousness and Reality Questionnaire (BACARQ). Imants Barušs and Robert Moore developed the BACARQ in 1987 as a self-report questionnaire with 38 items (Barušs & Moore, 1992, 1998). Questions one to eight use a four-point Likert scale with one representing "Definite No" and four representing "Definite Yes." Questions 9 to 38 use a seven-point Likert scale with one representing "Strongly Disagree" and seven representing "Strongly Agree." The seven dimensions that are measured with this questionnaire include Antiphysicalism, Religiosity, Meaning, Extraordinary Experiences, Extraordinary Beliefs, Inner Growth, and Transcendentalism, which is the global scale made up of all items. A higher score on the global scale represents more transcendental beliefs. The Cronbach's alpha for all of the items totaled to form a single scale was $\alpha = 0.95$ with items 9, 19, 24, 29, and 32 being reverse-scored items. A sample item from the Antiphysicalism dimension is Item 9, "There is no reality other than the physical universe." The questionnaire was used in both experiments.

Expressions of Spirituality Inventory (ESI). Douglas MacDonald developed the revised version of the ESI in 2000 (2000a, 2000b); and the inventory contains a total of 32 items. This instrument uses a five-point Likert-type scale from zero to four, with zero being "Strongly Disagree"

and four being "Strongly Agree." The inventory measures five descriptive dimensions of spirituality including an Experiential/Phenomenological dimension, Cognitive Orientation toward Spirituality, Existential Well-Being, Paranormal Beliefs, and Religiousness. Higher scores represent more spiritual beliefs. Cronbach's alpha for the individual dimensions varied between α = 0.80 and α = 0.89. Reverse-scored items are items 3, 8, 13, 18, 19, 23, and 28. A sample item from the Experiential/Phenomenological dimension is, "I have had an experience in which I seemed to be deeply connected to everything." The inventory was used in both experiments.

Phenomenology of Consciousness Inventory (PCI). Ronald Pekala developed the PCI in 1991 (1991a, 1991b). This inventory is a retrospective report including 53 items that are used to assess the state of consciousness a participant found themself in during a specific time period using a seven-point scale with opposing statements on opposite ends of each scale. The PCI was used in both experiments to evaluate a participant's state of consciousness while the FieldREG software and the PEAR Classic REG software registered input from the REG or PseudoREG. The scale includes 21 subscales and dimensions of subjective experience: Joy, Sexual Excitement, Love, Anger, Sadness, Fear, Body Image, Time Sense, Perception, Meaning, Imagery Amount, Imagery Vividness, Direction of Attention, Absorption, Self-Awareness, Altered State, Internal Dialogue, Rationality, Volitional Control, Memory, and Arousal. All of the subscales were checked to see if they could predict the difference between high- and low-intention runs, but the altered states subscale was of particular interest. The Cronbach's alpha for the individual subscales ranged from α = 0.72 to α = 0.91, and a sample item from the altered state subscale is: "My state of consciousness was not any different from or more unusual than what it ordinarily is 0 1 2 3 4 5 6. I felt in an extremely different and unusual state of consciousness."

Questions about Experience. This form was given at the end of both experiments and includes an open-ended question about the participant's experience while interacting with the REG, followed by two Likert-type questions with a five-point scale, where one represents "definitely not" and five represents "definitely yes." The first Likert-type question measures whether or not participants felt that they had been

able to alter REG functioning, and the second measures a participant's sense of connectedness with the REG. These three questions can be found in Appendix E.

Psyleron FieldREG Software. FieldREG software that was developed by Psyleron and loaded on the laboratory computer, was used to gather and quantify non-intentional data from the REG while participants were filling out the questionnaire and inventories at the beginning of the session. The REG was accumulating data passively.

Psyleron PEAR Classic REG Software. PEAR Classic REG software that was developed by Psyleron and loaded on the laboratory computer, was used to gather and quantify data from the REG or PseudoREG during the intentional runs and, thus, to measure possible direct mental influence. The PEAR Classic program was used for both experiments and it is a computer program that is a recreation of the original protocols used at the Princeton Engineering Anomalies Research laboratory at Princeton University. Each participant was asked to perform a total of 20 runs, and a balanced series was required so that participants were asked to perform 10 high-intention runs and 10 low-intention runs. A participant's performance is shown on the computer screen in real-time through the use of a cumulative deviation graph. The difference between cumulative averages for high-intention runs and low-intention runs was used as a dependent measure.

Procedure

Experiment 1 and Experiment 2 were conducted in a designated Psychology Laboratory on the King's University College campus after receiving appropriate ethics approval for research with human subjects. Initially, each participant was greeted and asked to review and sign a consent form. The consent form contained information about the purpose of the study and the role of the REG and FieldREG in such experiments. The participant was informed that FieldREG software would be registering input from the REG as it ran passively while three forms were completed in the following order: a demographics and attitudes form, the BACARQ, and the ESI. Subsequently, the REG was turned off and the participant was asked to fill out the PCI based on her subjective experience while filling out the initial survey package.

The FieldREG software was turned off while the participant filled out the PCI because the PCI was administered to measure the participant's subjective experience while the FieldREG software was running passively.

Experiment 2 differs from Experiment 1, in that a meditation component was added to the procedure in Experiment 2 prior to introducing a participant to the PEAR Classic program. The PEAR Classic program is the program that was used when a participant was asked to consciously deviate a randomly generated line that was displayed on the computer screen toward their pre-stated intention, based on their own volition, for a total of 20 runs. A balanced series was required, and therefore it was necessary that the participant complete 10 high-intention runs and 10 low-intention runs in an order of their choice. "High intention" and "low intention" are operationally defined as the behavioral selection of high-intention and low-intention runs, respectively. During a high-intention run, the participant's goal was to increase the value of the mean, and in a low-intention run, the participants' goal was to decrease the value of the mean. If the difference between the high and low mean cumulative deviations is statistically different from the expected mean, then it would appear that there is a correspondence between intention and the functioning of the electronic device through either direct mental influence or precognition.

Once the series of runs was completed in both Experiment 1 and Experiment 2, the PEAR Classic program was turned off, and the participant was asked to fill out the PCI for a second time, in order to evaluate the nature of a participant's subjective experience while interacting with the PEAR Classic program. After that, the participant was asked to fill out a final form, which consisted of three questions about their experience with the REG which were administered to discover any psychological variables that may be associated with significant deviations. Finally, the participant was asked to review a debriefing form, and any participants from the participant pool were given an opportunity to complete the bonus assignment in order to receive course credit.

Design

Correlations between the predictor variables and the criterion variable were analyzed in order to identify any significant relationships in both experiments. FieldREG mean scores, BACARQ composite scores, ESI cumulative scores, PCI scale scores, scores representing connectedness with the REG, and scores representing belief about REG influence served as predictor variables, and the mean difference between high- and low-intention runs served as the criterion variable; all variables are continuous. Moreover, the data from the sample in Experiment 1 and the sample in Experiment 2 were compared using an independent samples *t*-test in order to determine if the sample means differed significantly, potentially indicating that the changes in participants, equipment, and protocol in Experiment 2 may promote successful deviations in the intended direction.

EXPERIMENT 1

Method

In Experiment 1, the REG was used as the signal source for the Psyleron FieldREG software and the PseudoREG was used as the signal source for the PEAR Classic REG program. The REG was set up at 5 trials per second with each trial consisting of 200 bits for the Psyleron FieldREG software. For the PEAR Classic program, the PseudoREG was set up at 4 trials per second, 50 trials per run, and 1,000 total trials. There were no environmental manipulations, no meditation and visualization exercises, nor visualization suggestions prior to participants interacting with the PEAR Classic program.

Results

When testing our hypotheses, adjustments were not made for multiple analyses since the hypotheses were prestated, and, furthermore, none of them was confirmed for a critical value of .05. Where we do find effects in post hoc analyses, the results need to be interpreted with care, given that the probability of a Type I error increases with the number of analyses that are carried out. However, adjusting for multiple analyses, for instance with a Bonferroni correction, increases

the probability of Type II errors. So, unless otherwise noted, we simply report what we found for the reader to consider.

Hypothesis 1. In order to determine if there was a significant deviation in the intended direction, the difference between cumulative scores for high intention runs and cumulative scores for low intention runs was analysed using a one-sample Student's *t*-test. The mean difference for high- and low-intention runs was –.083 (*SD* = .36) and the *t* statistic was not significant, with $t(29) = -1.26$ ($p = .22$, two-tailed). These findings do not provide support for direct mental influence in the intended direction.

Hypothesis 2. A stepwise linear regression was used to determine if the criterion variable, the mean difference between high- and low-intention runs, could be predicted from the values of the predictor variables. Hypothesis 2 was tested by examining the correlation between the mean difference between high- and low-intention runs and FieldREG mean scores. FieldREG mean scores are representative of trials without directed conscious intention, while the mean differences between high- and low-intention runs are representative of trials with intention. The correlation between the predictor variable and the criterion variable was $r(28) = .06$, $p = .75$ (two-tailed), but the predictor variable was not entered into the regression equation because the probability of the correlation between FieldREG averages and the mean differences between high- and low-intention runs was above .05. In other words, trials without directed conscious intention did not predict trials completed with intention.

Hypothesis 3. The correlation of composite scores on the Beliefs About Consciousness and Reality Questionnaire with the criterion variable was insufficiently significant for the variable to be entered into the regression equation, $r(27) = -.10$, $p = .61$ (two-tailed). Therefore, individuals with a high composite score on the BACARQ, which is indicative of transcendental beliefs, were not more likely to deviate the REG in the intended direction.

Hypothesis 4. The largest correlation of a scale from the Expressions of Spirituality with the criterion measure was that of Cognitive Orientation toward Spirituality with $r(28) = -.12$, $p = .54$ (two-tailed). These findings provide no evidence in support of high scores on the ESI being indicative of an ability to deviate the REG in the intended direction.

Hypothesis 5. In order to determine if an altered state of consciousness would be indicative of an ability to deviate the REG in the intended direction, the altered state subscale scores on the second administration of the PCI were used as a predictor variable. The predictor variable was not entered into the regression equation because the correlation between the predictor variable and the mean difference between high- and low-intention runs, $r(27) = -.04$, $p = .85$ (two-tailed), was above .05. It is important to note that a new binary variable was created representing the direction of the deviation. A 'one' signifies a positive difference between high- and low-intention runs, or a deviation in the intended direction, whereas a 'zero' signifies a negative difference, and therefore a deviation in the direction opposite to intention. The correlation between the altered states subscale scores on the second administration of the PCI and a positive difference between high and low intention runs was statistically significant, $r(27) = .40$, $p = .03$ (two-tailed). When checking for a difference between the two groups using ANOVA, Levene's test for equality of variances was significant, and therefore, when equality of variances was not assumed, the independent samples *t*-test was not significant, $t(10.92) = -1.89$, $p = .09$ (two-tailed). Thus, while suggestive, there is insufficient support that an altered state of consciousness while interacting with the REG is correlated with a deviation in the intended direction.

Hypothesis 6. The correlation between the criterion variable and the scores representing connectedness with the REG was not significant, $r(28) = .11$, $p = .56$ (two-tailed), and therefore the predictor variable was not entered into the regression equation. In other words, participants who identify with or feel a transcendental unity to the REG, are not more likely to deviate the REG in the intended direction. In a follow-up analysis, however, it was found that the scores representing connectedness with the REG were correlated with the love subscale on the second administration of the PCI, $r(28) = .65$, $p < .001$ (two-tailed). Moreover, the correlation of the criterion variable with a new variable, the change in the love subscale from the first administration of the PCI to the second administration, gives $r(27) = .39$ ($p = .04$, two-tailed) (Figure 1). That means that the change in the love subscale accounted for 15% of the variance in the mean

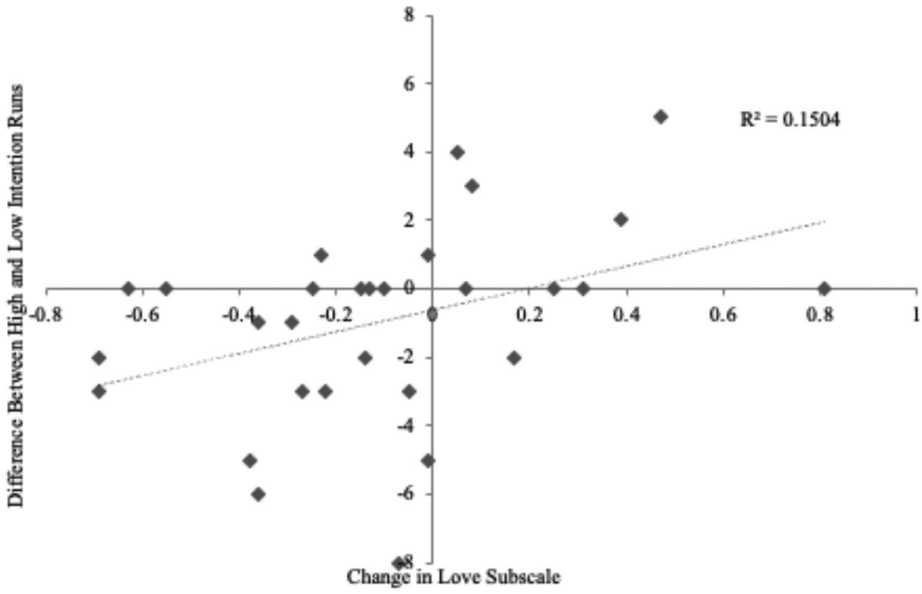


Figure 1. The relation between the change in the love subscale and the difference between high- and low-intention runs.

difference between high and low intention runs (Figure 1). If love is associated with a feeling of connectedness, and a change in love or an increase in love scores is associated with the difference between high and low intention runs, then a significant correlation between scores representing connectedness with the REG and the criterion variable could be revealed if there were more statistical power. This relationship may also be mediated by love. It is important to note that any such relationships are not necessarily due to the presence of anomalous variables. Participants who 'succeeded' in creating a deviation in the intended direction could simply have subsequently reported having had more immersive and positive experiences.

Hypothesis 7. To determine if beliefs about REG influence would predict an ability to deviate the REG in the intended direction, the belief score, which was accumulated prior to any interaction with the REG, was analyzed for statistical significance. The predictor variable was not entered into the regression equation, however, as it was insufficiently

TABLE 1
Correlations, Significance, and Sample Size of Predictor Variables with the Difference Between High- and Low-Intention Runs

Predictor Variable	Pearson Correlation	Significance (two-tailed)	*N*
FieldREG Average	.06	.75	30
BACARQ Composite Score	–.10	.61	29
ESI Cognitive Orientation	–.12	.54	30
Altered State Subscale Score	–.04	.85	29
Resonance Score	.11	.56	30
Belief Score	–.19	.31	30

significant, $r(28) = -.19$ ($p = .31$, two-tailed). A summary of the findings for each predictor variable can be found in Table 1.

Post Hoc Analyses. Significant correlations were found between FieldREG mean scores and education, as well as rationality ($r = -.401$, $p = .028$, $n = 30$). Now we do need to explicitly take into account the fact that there were multiple analyses. We did this by splitting the sample into two equal-sized parts to determine if the relationship was maintained in both samples despite considerable loss of statistical power. One way to think of this is to conceptualize one half of the sample as the experiment in which the effect was found, and the other half of the sample as a replication experiment. Education lost its significance on each of the two random samples, but the correlation between rationality and FieldREG mean scores remained significant in one of the two random samples, $r(13) = -.81$, $p < .01$ (two-tailed), although the effect was not replicated in the other, $r(13) = .20$, $p = .47$ (two-tailed). Nonetheless, because the correlation between rationality and FieldREG mean scores showed up again in Experiment 2, it is reported here.

Discussion

There was no evidence in support of a deviation in the intended direction. Furthermore, none of the individual characteristics hypothesized were indicative of an ability to deviate the REG in the intended direction. The correlation between FieldREG mean scores and rationality provides some evidence suggesting that excessive cognitive analysis may have a noticeable effect on an REG. The love subscale on the second administration of the PCI was correlated with scores representing connectedness with the REG, and a change in love between both administrations of the PCI was significantly correlated with the difference between high- and low-intention runs. In other words, the unification of an individual's sense of identity with the machine or empathizing with the machine may facilitate the information transfer between one's consciousness and the REG through the presence of love (Jahn, 1996).

In terms of limitations, the PseudoREG was used as the electronic noise source for trials with intention as a result of a programming error. Jahn et al. (1987) notes, however, that the PseudoREG and REG are identical in terms of the feedback provided and the experimental protocol used. Moreover, the results of 29 experimental series with a PseudoREG at the PEAR lab, confirmed the ability of operators to produce significant deviations using such experimental protocols (Jahn et al., 1987).

Feelings of love and silencing of excessive cognitive noise may improve the rate at which successful deviations occur, and the meditation and visualization component added in Experiment 2 will explore the effect of priming such emotions and perceptions.

EXPERIMENT 2

Method

The designated psychology laboratory at King's University College was strategically decorated in an attempt to produce a relaxing environment in Experiment 2. Moreover, an unsystematic effort was made to recruit participants, such as natural healers, who believed that they had some ability to directly manipulate physical reality. The

Psyleron FieldREG software was set up at 5 trials per second with each trial consisting of 200 bits, and the FieldREG program registered input while participants filled out the initial survey package. After completion of the first PCI form, and prior to interacting with the PEAR Classic program, participants were guided through a 2- to 3-minute relaxation meditation, followed by a 3- to 5-minute guided imagery exercise. Subsequently, participants were offered visualization suggestions and strategies that were intended to promote direct mental influence in the intended direction. PEAR Classic REG trials then commenced. For those runs, the REG was set up at 4 trials per second, 50 trials per run, and 1,000 total trials.

Results

Hypothesis 1. Prior to confirming whether or not the meditation and visualization techniques used in Experiment 2 promoted successful deviations of the REG, a two-tailed single-sample *t*-test was conducted to test the mean difference between cumulative scores for high intention-runs and low-intention runs and the constant value zero, to determine if participants were significantly able to alter the functioning of the REG. A statistically significant difference was found, $t(29) = 2.66$ ($p = .01$, two-tailed, Cohen's $d = 0.49$), suggesting that there was a significant separation in the intended direction (Figure 2). In an attempt to establish whether or not participants who engaged in meditation and visualization exercises exhibited more successful deviations than participants who did not, comparisons were made with Experiment 1. An independent samples *t*-test was conducted comparing mean differences for high- and low-intention runs in both samples. A significant difference was observed between Experiment 1 ($M = -.08$, $SD = .36$) and Experiment 2 ($M = .15$, $SD = .31$), with $t(58) = -2.69$ ($p = .009$, two-tailed). Since the separation of high and low intention runs is the single overall outcome measure, no correction for multiple analyses is required. This suggests that some of the differences between the conditions of Experiment 1 and Experiment 2, such as participating in meditation and visualization exercises prior to interacting with the REG, may enhance the likelihood of successful deviations.

Hypothesis 2. In Experiment 1, a change in love across both administrations of the PCI was correlated with the mean difference

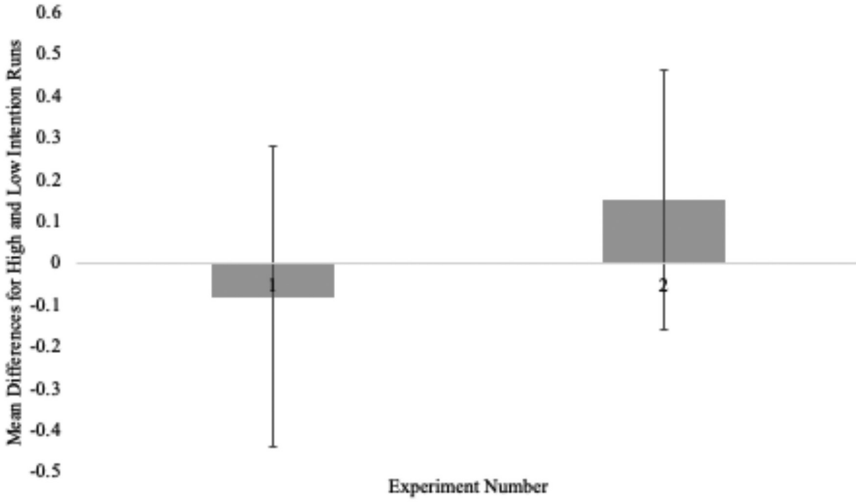


Figure 2. Mean differences for high- and low-intention runs in Experiment 1 and Experiment 2. Error bars indicate the standard deviation.

for high and low intention runs. However, these findings were not replicated in Experiment 2, $r = -.12$, $p = .55$ (two-tailed). Moreover, the correlation between love subscale scores on the second administration of the PCI and the mean difference for high and low intention runs was not significant, $r(28) = -.26$, $p = .16$ (two-tailed) and in the opposite direction. A one-way analysis of variance was conducted to investigate the differences between scores for the love subscale on the second administration of the PCI for both experiments. The results revealed a statistically significant difference between the love subscale scores obtained from the second half of the two experiments, $F(1,58) = 4.31$, $p = .04$ (two-tailed) (Figure 3). This difference was in the expected direction with $M = 4.57$ ($SD = 4.14$) for Experiment 2 in comparison with $M = 2.63$ ($SD = 2.98$) for Experiment 1. The difference between love scores on the first administration of the PCI was not different from Experiment 1 to Experiment 2, with $F(1,57) = .21$ ($p = .65$), thereby providing some confirmation that the manipulation had the intended effect of increasing feelings of love. Thus, given that participants in Experiment 2 were more likely to successfully deviate the REG, there is some support that feelings of love could be a factor in direct mental influence.

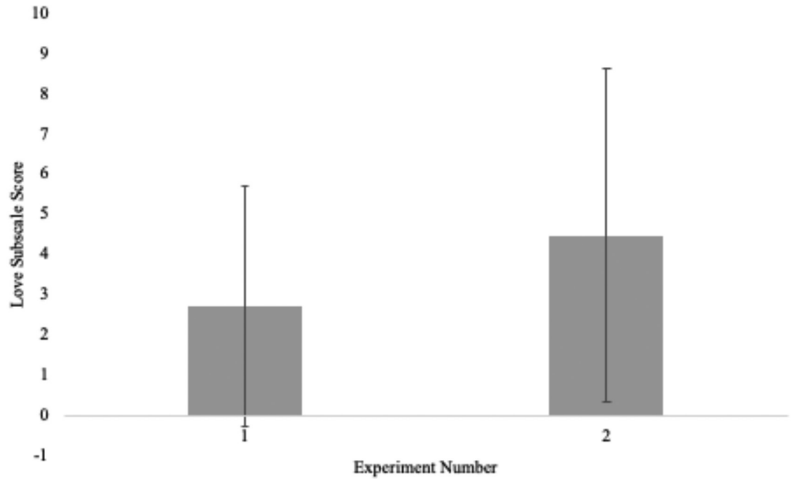


Figure 3. Love subscale scores for Experiment 1 and Experiment 2. Error bars indicate the standard deviation.

Hypothesis 3. Participants who scored high in rationality on the first administration of the PCI were not less likely to deviate the REG in the direction of their previously stated intent, $r(28) = -.28$, $p = .13$ (two-tailed). There was, however, a significant correlation between rationality and FieldREG averages, $r(28) = -.38$, $p = .04$ (two-tailed) (Figure 4). This inverse effect was also significant in Experiment 1, and it is suggestive

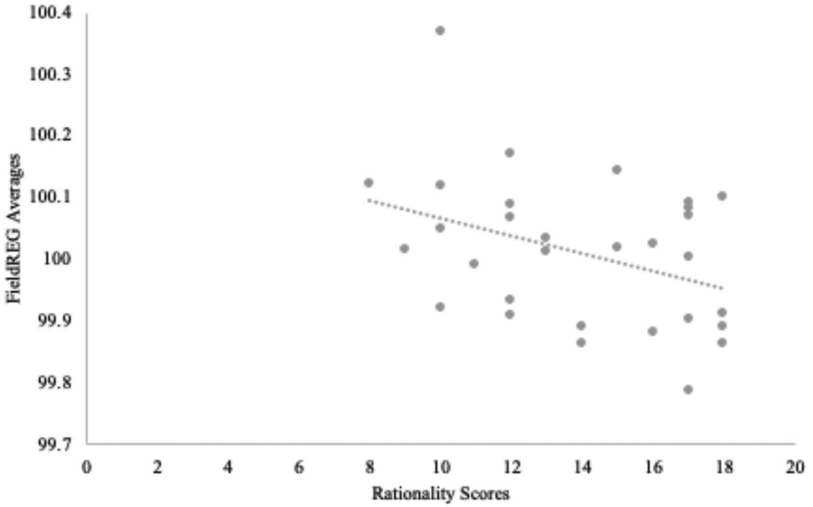


Figure 4. The correlation between rationality scores and FieldREG averages. As rationality scores increase, FieldREG averages appear to trend downward.

that individuals who score high in rationality may be more likely to deviate the FieldREG in the negative direction. To appreciate the significance of this result, it is to be noted that only one of 21 PCI scales was statistically significantly correlated with the FieldREG averages in Experiment 1. That the same PCI scale is again the one that is statistically significant in Experiment 2 and in the same direction has a probability of only .024. This appears to be a signal in the noise.

A summary of the findings for the predictor variables in Experiment 2 can be found in Table 2.

TABLE 2
Correlations, Significance, and Sample Size of Predictor Variables with the Difference Between High- and Low-Intention Runs

Predictor Variable	Pearson Correlation	Significance (two-tailed)	*N*
Love Subscale Score	–.26	.16	30
Rationality Subscale Score	–.28	.13	30

Discussion

Results revealed a significant deviation of the REG in the direction of the participants' volition. Moreover, comparisons between cumulative deviations for high- and low-intention runs across both samples were found to be statistically significant. These findings offer support for the first hypothesis, indicating that the incorporation of meditation and visualization exercises prior to interaction with the REG may significantly influence an individual's ability to deviate the REG in the intended direction.

The results of Experiment 2 offer only partial support that feelings of love facilitate direct mental influence, and that rationality may create a deviation of the REG. However, mean love subscale scores gathered from the second administration of the PCI increased in Experiment 2. The manipulation in Experiment 2 was designed to initiate feelings of

love, and participants in Experiment 2 were also found to be more likely to produce significant deviations in the intended direction. Perhaps, if there were more statistical power, then love subscale scores may have been a predictor for the mean difference between high- and low-intention runs overall.

It is important to note that an experimenter effect may have been present in Experiment 2 as two experimenters worked in collaboration to collect the data and the experiment required more direct interaction with the participants beyond the simple instruction given in Experiment 1. The meditation and visualization scripts were recited by one of the two experimenters, and visualization suggestions also were provided. Furthermore, the experimenters may have each played a role in directly altering the function of the REG. Upon investigation, there was no significant difference in the deviation scores between the two experimenters $F(2,57) = 2.68$, $p = .08$ (two-tailed), although it is possible that both contributed equally to the elevated scores.

Another potential oversight was identified after half of the data had been collected as there was confusion regarding the correct method to fill out the PCI. Specific instruction on how to fill out the inventory was not given for the first half of the participants in Experiment 2, and as a result statistical power may have been lost and some of the relationships that exist between the variables may have been missed.

GENERAL DISCUSSION

Interpretations

One explanation for the successful deviations in Experiment 2 is that the tension-releasing effects of the meditation component reduced anxiety levels sufficiently so as to not interfere with direct mental influence. As previously mentioned, individuals experiencing high levels of anxiety have been shown to produce psi-missing effects. In fact, creativity has been found to be linked with elevated psi-hitting scores; however, when creativity was accompanied by anxiety, the scores were negative (Carpenter, 2012).

Another plausible interpretation is that the visualization element, as well as the meditation component, may have encouraged participants to tap into their nonconscious intentions. Carpenter (2012) found that

participants who presented a more active involvement in personal imagery, as well as an emotional openness to it, were more likely to produce extreme deviations. Participants who experienced imagery that contained high levels of intellectualization and cognitive analysis, on the other hand, were more likely to produce scores that did not deviate significantly in any direction. Rationality had a negative relationship with FieldREG averages in both experiments, and although there is no intention to deviate the REG in either direction, this may suggest that excessive cognitive analysis hinders psi-hitting effects.

As previously described, creativity has been associated with psi-hitting effects, and this may be due to the fact that the creative process requires a suspension of cognitive analysis for a sufficient amount of time so as to be able to access the nonconscious, our implicit sense, or for our purposes here, our nonconscious intentions (Carpenter, 2005). Meditation and visualization techniques promote creativity and an uninterrupted openness, and this may be how intentional stability at the psi level is maintained.

Limitations

Feedback. With regard to limitations, correlations with the love subscale on the PCI may be the result of a priming effect caused by the feedback given to participants regarding the results of their interactions with the REG. For example, if the mean increased or decreased in a manner consistent with the participant's intention, then this might result in the participant being in a more positive or "loving" mood. A solution to this would be to remove participant feedback.

Sampling Differences. Experiment 2 sampled fewer university students than Experiment 1 and included a larger proportion of participants who expressed interest in consciousness or belief in anomalous abilities. Thus, participants in Experiment 2 may have been more likely to produce successful deviations, due to individual characteristics as well. It is possible that these participants may have been more likely to produce a signification deviation in the intended direction because they were less anxious about, and more open to, psi phenomena.

Experimenter Effect and Psi-Missing. There are enigmatic aspects of studying direct mental influence, including psi-missing and the

nonconscious reversal of conscious intentions, as well as experimenter effects. Not only may experimenters indirectly influence the collection of data, but the significant deviation in the intended direction that was found in Experiment 2 may have been in part or entirely due to the experimenters' psi-giftedness. Moreover, the inability to find a significant deviation in the intended direction for Experiment 1, may also be due to a possible experimenter effect.

Conclusions

As per Carpenter's First Sight Theory, psi phenomena are presumed to be nonconscious psychological processes that precede and shape all experience. Considering that these processes appear to function in a transient manner, they are difficult to investigate. A conservative evaluation of the evidence for psi phenomena is that results are statistically anomalous and further scientific inquiry is required; a more realistic evaluation is that anomalous phenomena are very likely occurring in the world around us, and to an extent that is beyond what can presently be explained by conventional science (Broderick & Goertzel, 2014).

In fact, just because psi phenomena conflict with the current scientific understanding of reality, does not mean the results should be disregarded. There is an abundance of examples of newly discovered phenomena that have adjusted science's view of reality accordingly (Broderick & Goertzel, 2014). For instance, Peter Higgs submitted a paper to a notable physics journal in 1964. The paper was rejected because it contained the premise of an invisible element pervading space and interacting with particles so as to supply their mass. What is of importance is that Higgs maintained his scientific position and his premises were eventually accepted (Broderick & Goertzel, 2014). Despite our expectations for conventional explanations, conventional explanations, they may not always be the best ones for the phenomena occurring around us.

As a suggestion for future research, participants could be preselected if they were to exhibit some psi abilities, for example through the use of the Ball Selection Test (BST). In this test, a number from one through five is written on separate balls, and a participant is asked to guess the number on the ball that she will select from a bag

containing an assortment of numbered balls. In one case, a sample of preschool children performing the BST yielded a high effect size (Broderick & Goertzel, 2014). It was noted that the high effect size could have been due to the fact that the experimenter was exceptionally successful at the BST task, but this could also have been the result of children's creativity and imagination. Although the BST measures precognition and clairvoyance, it may nevertheless be useful for prescreening participants in experiments of direct mental influence.

Furthermore, current research concerning psi phenomena supports also preselecting participants on the basis of their acceptance of psi phenomena, previous transcendental experiences, the practice of meditation and visualization, and the possession of psychological characteristics such as extraversion, warmth, and love (Broderick & Goertzel, 2014). The collective mental activity of individuals should also continue to be investigated with REG devices. Our understanding of consciousness and reality is in its infancy, and it is only through investigation and the accumulation of data that a scientific understanding of reality can be actualized.

ACKNOWLEDGMENTS

This research was supported by donations from Medical Technology (W. B.) Inc. and from internal research grants from King's University College. The authors thank their research assistants: Kasha Herba for contributing to the design of the second study and interacting with some of the participants, and Shannon Foskett for editing the manuscript of the paper. Experiment 1 was the first author's undergraduate honors thesis in psychology supervised by the third author; Experiment 2 was the second author's undergraduate independent study project supervised by the third author. The first author wrote up the paper for publication with assistance from the second and third authors.

REFERENCES

Barušs, I. (2007). *Science as a spiritual practice.* Imprint Academic.

Barušs, I. (2020). *Alterations of consciousness: An empirical analysis for social scientists* (2nd ed.). American Psychological Association.

Barušs, I., & Moore, R. J. (1992). Measurement of beliefs about consciousness and reality. *Psychological Reports, 71*(1), 59–64. https://doi.org/10.246/pro.1992.71.1.59

Barušs, I., & Moore, R. J. (1998). *Beliefs about consciousness and reality questionnaire.* Unpublished test manual.

Barušs, I., & Mossbridge, J. (2017). *Transcendent mind: Rethinking the science of consciousness.* American Psychological Association.

Braud, W. (2003). *Distant mental influence: Its contributions to science, healing, and human interactions.* Hampton Roads Publishing.

Broderick, D., & Goertzel, B. (2014). *Evidence for psi: Thirteen empirical research reports.* McFarland.

Carpenter, J. C. (1971). The differential effect and hidden target differences consisting of erotic and neutral stimuli. *Journal of the American Society for Psychical Research, 65*(2), 204–214.

Carpenter, J. C. (2004). First sight: Part one, a model of psi and the mind. *The Journal of Parapsychology, 68*(2), 217–254.

Carpenter, J. C. (2005). First sight: Part two, elaboration of a model of psi and the mind. *The Journal of Parapsychology, 69*(1), 63–112.

Carpenter, J. C. (2012). *First sight: ESP and parapsychology in everyday life.* Rowman & Littlefield.

Dunne, B. J., & Jahn R. G. (1992). Experiments in remote human/machine interaction. *Journal of Scientific Exploration, 6*(4), 311–332.

Dunne, B. J., Nelson, R. D., & Jahn, R. G. (1988). Operator-related anomalies in a random mechanical cascade. *Journal of Scientific Exploration, 2*(2), 155–179.

Fox, K. C. R., Dixon, M. L., Nijeboer, S., Girn, M., Floman, J. L., Lifshitz, M., Ellamil, M., Sedlmeier, P., & Christoff, K. (2016). Functional neuroanatomy of meditation: A review and meta-analysis of 78 functional neuroimaging investigations. *Neuroscience and Behavioural Reviews, 65*, 208–228. https://doi.org/10.1016/j.neubiorev.2016.03.021

Jahn, R. G. (1996). Information, consciousness, and health. *Alternative therapies, 2*(3), 32–38.

Jahn, R. G., Dunne, B. J., & Nelson, R. D. (1987). Engineering anomalies research. *Journal of Scientific Exploration, 1*(1), 21–50.

Jahn, R. G., Dunne, B. J., Nelson, R. D., Dobyns, Y. H., & Bradish G. J. (1997). Correlations of random binary sequences with pre-stated operator intention: A review of a 12-year program. *Journal of Scientific Exploration, 11*(3), 345–367.

Jahn, R. G., Dunne, B. J., & Dobyns, Y. H. (2006). Exploring the possible effects of Johrei techniques on the behavior of random physical systems. *Semantic Scholar Technical Report*, 1–30. https://www.semanticscholar.org/paper/Exploring-the-Possible-Effects-of-Johrei-Techniques-Jahn-Dunne/69743a0

31e99f12a355049cabe7bf2d78c8a3acf
Kuhn, T. S. (1970). The structure of scientific revolutions (2nd ed.). University of Chicago Press.
MacDonald, D. A. (2000a). Spirituality: Description, measurement, and relation to the five factor model of personality. *Journal of Personality, 68*(1), 153–197.
MacDonald, D. A. (2000b). *The expressions of spirituality inventory: Test development, validation and scoring information.* Unpublished test manual.
Margolin, I., Pierce, J., & Wiley, A. (2011). Wellness through a creative lens: Meditation and visualization. *Journal of Religion & Spirituality in Social Work: Social Thought, 30*(3), 234–252. https://doi.org/10.1080/15426432.2011.587385
Mertz, H. (2020). *The selection effect: How consciousness shapes reality*. Penn Wolcott Press.
Nelson, R. D., Bradish, G. J., Dobyns, Y. H., Dunne, B. J., & Jahn, R. G. (1996). FieldREG anomalies in group situations. *Journal of Scientific Exploration, 10* (1), 111–141.
Nelson, R. D., Jahn, R. G., Dunne, B. J., Dobyns, Y. H., & Bradish G. J. (1998). FieldREG II: Consciousness field effects: Replications and explorations. *Journal of Scientific Exploration, 12*(3), 425–454.
Padfield, S. (1980). Mind–matter interaction in the psychokinetic experience. In B. S. Josephson & V. S. Ramachandran (Eds.), *Consciousness and the physical world: Edited proceedings of an interdisciplinary symposium on consciousness held at the University of Cambridge in January 1978 (pp. 165–175).* Pergamon Press.
Pekala, R. J. (1991a). *Quantifying consciousness: An empirical approach*. Plenum Press.
Pekala, R. J. (1991b). *The phenomenology of consciousness inventory.* Mid-Atlantic Educational Institute.
Psyleron. (2009). *REG-1 user manual.* Psyleron Technologies and Research. Psyleron.com
Radin, D., Michel, L., Galdamez, K., Wendland, P., Rickenbach, R., & Delorme, A. (2012). Consciousness and the double-slit interference pattern: Six experiments. *Physics Essays, 25*(2), 157–171.
Schmidt, H. (1971). Mental influence on random events. *New Scientist and Science Journal, 50*(757), 757–758.
Varvoglis, M. P., & McCarthy, D. (1986). Conscious-purposive focus and PK: RNG activity in relation to awareness, task-orientation, and feedback. *Journal of the American Society for Psychical Research, 80*(1), 1–29.
Walach, H., Horan, M. Hinterberger, T., & von Lucadou, W. (2020). Evidence for anomalistic correlations between human behavior and a random event generator: Result of an independent replication of a micro-pk experiment. *Psychology of Consciousness: Theory, Research, and Practice, 7*(2), 173–188.

APPENDIX A
RELAXATION MEDITATION SCRIPT

I will now guide you through some imagery exercises for the purpose of allowing you to relax more deeply. Begin by settling your body into a comfortable sitting position and allowing your eyes to gently close. . . . Let your awareness shift to your breathing. . . . Allow yourself to let go of any thoughts or concerns that may have accumulated during the day. . . . Simply direct your focus on what you are experiencing here and now. . . . As you continue to breathe, observe your body and scan for any areas that may feel tense. You may notice some tension in your neck or shoulders. . . . Your back. . . . Feet. . . . Or perhaps, your jaw feels tight. . . . Wherever the tension lies, direct attention to the source and focus on releasing any tension that may feel stuck in this particular area. . . . With each outbreath, consciously say to yourself, "release." . . . Imagine the tension being washed away. . . . Continue to breathe. . . . and feel the relief that follows as the tension is released from this area. . . . When you feel ready to move on, scan your body once again and select another area that may feel tense. . . . Direct your attention towards the source of this tension. . . . Again as you exhale, consciously say to yourself "release" . . . and imagine the area being cleared of all tension. . . . Over the next few breaths, focus on releasing tension from this part of your body and allow this area to feel relaxed and soothed.

APPENDIX B
VISUALIZATION EXERCISE SCRIPT

We will now focus on tapping into our imagination through the process of visualization. If the practice of visualization is new to you or you find that the images are unclear in your imagination, feel free to follow along and imagine the sequence of events in whatever way is most comfortable to you. We will begin very simply by walking. Imagine yourself walking through a lush forest. It's the break of dawn in early summer. ... As the sun rises it paints the sky with the most vibrant hues. Splashes of orange, purple, yellow, and pink are reflected in the big, fluffy clouds above as beams of white light radiate through each opening. The air feels brisk, but you feel perfectly comfortable. The soft cozy sweater you are wearing is keeping you nice and warm. As you breathe deeply, filling your lungs with the cool fresh air, you notice how rejuvenating it feels to do so, almost as though the forest were cleansing you in some way. As you continue walking, you notice the sun periodically peeking through the treetops to shine down upon you. You stop for a moment to feel the warmth of the sun's rays on your face. Let the feeling sink in. . . . As you pause there, basking in the sunlight, you happen to notice the soft sound of birds chirping

in the trees and the rustle of leaves in a gentle breeze, . . . but there is mostly silence. . . . You notice how peaceful the absence of sound can be. There is a new level of clarity. As you continue on your journey, you glance down at your feet and notice that the path beneath you is made of soft, warm sand. You wiggle your toes. That feels good. As you look up you notice a clearing up ahead . . . and begin walking towards the opening in the forest. As you walk, you look around and admire the rich colours of the plants and flowers around you. The forest feels alive. You bend down to examine a flower . . . noticing its colours, caressing its leaves, drinking in the scent emanating from its blossoms. The fresh, sweet smell stays with you as you continue along the path. As you near the clearing, you notice that there is someone waiting to greet you. As you get closer, you recognize that this is a person you know who loves you very deeply. This can be someone real or imaginary. The person is smiling at you and waving you over. You pick up the pace . . . and feel joy welling up inside of you as your legs move faster and faster . . . moving you closer and closer. You finally reach each other, and they wrap you in their arms. They tell you how proud they are of you and what you are creating in this world. You take a moment to look at each other, before walking down to a nearby pond. As you take a seat on the grass, you see frogs leaping from their lily pads and splashing into the water. You take a deep breath and as you exhale, once again notice the sun shining down on you and warming your cheeks. You think to yourself, what a peaceful day. . . . When you are ready to do so, return to the room and open your eyes.

APPENDIX C
VISUALIZATION SUGGESTIONS

During this stage of the experiment your goal will be to intend the center line to move up (for a high-intention run) or down (for a low-intention run). There will be a total of 20 runs; 10 of which must be high, which will appear as red lines, while the other 10 must be low, which will appear as blue lines. At the beginning of each run, you will have the option of selecting which direction you wish to set your intention. If you would like to intend the line to move up on the screen, it may be beneficial to imagine that the line has a weightless quality to it . . . or that it is taking off towards the top of the screen. Similarly, if you would like to intend the line to move down, it might help to imagine that there is a heavy quality to the line . . . or that it is sinking down to the bottom of the screen. While initially setting your intention is important, it is best not to become too absorbed in the small, inevitable fluctuations that the line will make during the course of each run. Simply focus on the big picture and the intended direction you would *like* the line to move. When you are ready, we can begin.

APPENDIX D
DEMOGRAPHICS AND ATTITUDES FORM

Name: _____ **Age:** _____

Gender: ☐ Female ☐ Male

Highest level of education:

☐ High School Graduate ☐ College Graduate ☐ Post-graduate Degree ☐ None of these

Religious Affiliation:

☐ Buddhist ☐ Judaic ☐ Christian ☐ Muslim ☐ Own Beliefs ☐ None

☐ Other (Please specify): _____

Frequency of religious practice:

☐ Daily ☐ Weekly ☐ Monthly ☐ Hardly Ever ☐ Never

Attitude toward REG:

Please rate your agreement with the following statement:

I think that I can alter the functioning of the REG.

☐ definitely not ☐ likely not ☐ don't know ☐ likely yes ☐ definitely yes

APPENDIX E
QUESTIONS ABOUT THE EXPERIENCE WITH THE RANDOM EVENT GENERATOR

1. Please describe your experience with the random event generator (REG).

Attitude toward REG:

Please rate your agreement with the following statements:

2. I think that I was able to alter the functioning of the REG.

☐ definitely not ☐ likely not ☐ don't know ☐ likely yes ☐ definitely yes

3. I felt that I was one with the REG.

☐ definitely not ☐ likely not ☐ don't know ☐ likely yes ☐ definitely yes

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 345–382, 2021 0892-3310/21

RESEARCH ARTICLE

Phenomenological Interpretations of Some Somatic Temporal and Spatial Patterns of Biophoton Emission in Humans

Daqing Piao

daqing.piao@okstate.edu
School of Electrical and Computer Engineering; and Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, Oklahoma, USA

Submitted October 10, 2019; Accepted January 27, 2021; Published June 15, 2021

https://10.31275/20211685

Abstract—Biophoton emission in humans remains intriguing in terms of the temporal and spatial patterns that indicate influences from environmental, physiological, and pathological factors, and even intentional faculty. We propose an analytical hypothesis for interpreting a few patterns of somatic steady-state biophoton emission from humans, including dependency on age, diurnal variation, and geometric asymmetry associated with serious asymmetrical pathological conditions. The analyses are based on associating a hypothetical collective state of autonomic neuro-energy, presented in a form of "vivodensity," with photo-genesis of biophoton emission. The vivodensity refers to the maximal coherence among the energy "modes" of neuronal control that one can engage in at a given time of life. This vivodensity is treated to modulate metabolic activities responsible for photo-genesis manifested as biophoton emission. The hypothesis projects a decrease of the vivodensity in humans during growth beyond puberty. The hypothesis also proposes a modification of the vivodensity by systemic or homeostatic physiology. The hypothesis further postulates that the deviation of the physiology-modified vivodensity from the prepuberty level is a deterioration due to organ-specific pathological conditions. A temporal differential change of vivodensity is hypothesized to proportionally modulate oxidative stress that functions as the physical source of biophoton emission. The resulting steady-state diffusion of the photon emitted from a photo-genic source in human geometry simplified as a large homogeneous spherical domain is mod-

eled by photon diffusion principles incorporating an extrapolated zero-boundary condition. Age and systemic physiology combined determine the intensity of the center-located physiological steady-state photo-genic source. An acquired pathology sets both the intensity and the off-center position of the pathological steady-state photo-genic source. When the age-commemorated, physiology-commanded, and pathology-controlled modifications of the steady-state photo-genic sources are implemented in the photon diffusion model, the photon fluence rate at the surface of the human-representing spherical domain reveals the patterns of age, the temporal variation corresponding to systemic physiology, and the geometric asymmetry associated with significant asymmetric pathological conditions as reported during spontaneous biophoton emission. The approach, which has the convenience of quantitative estimation of biophoton emission patterns with the potential to incorporate autonomic neuromodulation, may offer novel insights into biophoton phenomena wherein human faculty constitutes an experimental condition.

Keywords: biophoton emission; age; temporal variation; asymmetry; analytical model; photon diffusion; steady state

INTRODUCTION

Biophoton emission (Cifra & Pospisil, 2014) has been investigated over several decades under a variety of terms including the following: weak luminescence (Quickenden & Que Hee, 1974), low-level chemi-luminescence (Cadenas et al., 1980), spontaneous chemi-luminescence (Boveris et al., 1984), biophoton(s) emission (Cohen & Popp, 1997; Devaraj et al., 1997), ultra-weak bioluminescence (Wang & Yu, 2009), auto-luminescence (Havaux et al., 2006), spontaneous ultra-weak light emission (Moraes et al., 2012), etc. The spectrum of biophoton emission is interestingly very broad, spanning the visible band, and extending in both directions to ultraviolet and near-infrared bands (Boveris et al., 1980; Cadenas et al., 1980; Cadenas, 1984; Gallas & Eisner, 1987; Devaraj et al., 1997; Kayatz et al., 2001; Fedorova et al., 2007; Kalaji et al., 2012; Kobayashi et al., 2016; Wang et al., 2016; Zhao et al., 2017).

Several theories have been postulated about the origin of biophotons. Perhaps the most widely regarded is that the broad-band biophoton radiation can be attributed to the transition of excited biological molecules, primarily reactive oxygen species (ROS)

(Kobayashi et al., 2014). ROS are generated at a fixed rate by oxidation reduction reactions during cellular respiration, but they are toxic to living cells. When in homeostasis, the cellular organism employs a variety of scavenging mechanisms to maintain a relatively consistent concentration of ROS at very low levels (Kobayashi et al., 2014). The luminescence intensity of the baseline spontaneous biophoton emission of a living organism including humans is thus extremely low, on the order of hundreds of photons per square centimeter per second (Cohen & Popp, 1997; Zhang et al., 1997) when measured on the surface, whereas the intra-organism intensity has been speculated to possibly be substantially higher (Bokkon et al., 2010). For a photon at the visible wavelength of 500 nm, a photon count rate of 100 photons per second per square centimeter corresponds to an irradiance of 3.98×10^{-17} $W \cdot cm^{-2}$ or ~0.04 $fW \cdot cm^{-2}$. This irradiance is comparable to the photon fluence rate measured at 10 cm from a localized source of $1\mu W \cdot cm^{-3}$ in an unbounded homogeneous tissue medium having an absorption coefficient of 0.106 cm^{-1} and a reduced scattering coefficient of 10 cm^{-1} that are representative of soft tissue. The extremely small intensity makes spontaneous biophoton emission challenging to detect without highly sensitive photon-detecting devices carefully configured in a completely darkened environment.

In spite of the challenges in biophoton detection due to the ultraweak intensity, significant efforts and progress have been made in mapping biophotons from various regions of the human body (Ives et al., 2014). Many of these results indicated the potential of mapping biophotons for assessing holistic health, based upon some systemic patterns that biophotons from humans manifest. The variations of spontaneous biophoton emission intensity from humans in association with normal physiological phases or environmental influences have been reported on different temporal scales. Diurnal rhythms of spontaneous biophoton emission of humans have been linked to the systemic changes in energy metabolism inherent to a circadian cycle (Kobayashi et al., 2009). Frequency analysis of the spontaneous biophoton emission intensity revealed temporal characteristics with slow-periodicity components longer than 24 hours ranging from 7 days to 270 days (Cohen & Popp, 1997; Cohen & Popp, 2003). Seasonal variation of spontaneous biophoton emission intensity (Zheng et al.,

1983; Cohen & Popp, 2003; Jung et al., 2005) revealed as high as 4-fold changes over year-long measurements, with the lowest intensity in the autumn and the highest intensity appearing 6 months from autumn. Spontaneous biophoton emission has also manifested gender and age-related variations (Yang et al., 1995; Yang et al., 1996; Sauermann et al., 1999; He et al., 2016; Zhao et al., 2016). Biophoton emission intensity was observed to be higher among males than among females, and higher in adults than in children. The aged male adult had ~40% higher biophoton emission intensity than the aged female adult (He et al., 2016). The biophoton emissions of both males and females starts to increase by the age of 11–14 and stabilizes at about age 50 (He et al., 2016). These findings indicate that measuring biophoton emission can potentially provide insight into the homeostatic state or systemic stage, as well as the harmonic correlation between the human body and the environment that is regarded as fundamental in some alternative medical and healing practices (Sun et al., 2017). Deviations from spontaneous biophoton emission intensity from these healthy temporal rhythms thus may render information on the deviation of the systemic or homeostatic physiological states from normal levels.

The temporal variations of the human spontaneous biophoton emission intensity of normal physiological states also implies that a human state departing significantly from healthy conditions due to acquired pathology may manifest in variations of biophoton emission intensity that could be much stronger and potentially much more varied than those from a systemic cause. An acquired pathology that is not systemic but is organ- or tissue-confined could also cause the spontaneous biophoton emission pattern to be altered from a healthy balanced or symmetric configuration. An alteration of the biophoton emission by acquired organ- or site-specific pathology is likely to break the symmetry of the spontaneous biophoton emission expected for a balanced faculty. For example, a multiple sclerosis case was found to give ~200 biophoton counts/second in the right hand and ~300 biophoton counts/second in the left hand (Cohen & Popp, 1997). For hemiparesis patients, the hand with a hemiparesis aspect emitted fewer biophotons in comparison with the contra-lateral normal hand (Jung et al., 2003), and acupuncture treatment dramatically reduced the left–right asymmetry of biophoton emissions. The left–right asymmetry of

spontaneous biophoton emission in a mouse model of human breast cancer (Zhao et al., 2017) became more pronounced as the tumor load in the right axillary increased versus the contra-lateral normal side. These reports appear to suggest that the left–right asymmetry of spontaneous biophoton emission correlates with left–right pathological differences.

Additionally, a particularly intriguing presentation of biophotons in association with humans cannot be missed: The biophoton intensity seems to be modulated by intention or human interaction during healing or other various kinds of bioenergy practices (Nakamura et al., 2000; Haraguchi et al., 2001; Joines et al., 2012; Rubik & Jabs, 2017). Links have also been suggested between biophotons and observations that are difficult to measure and quantify, including consciousness (Rahnama et al., 2011), mind–matter manipulation (Caswell et al., 2014; Pederzoli et al., 2017), and paranormal phenomena at the moment of death (Persinger & St-Pierre, 2011; Reddy, 2016). One could argue that an experimental control that appears common to all these phenomena is the involvement of human factors, which at the physical level will reside in the engagement of neuronal activities, no matter whether autonomic or intentional. The variation in surface biophoton emission has been known to correlate with changes in metabolism. When living organisms become stressed (Slawinski et al., 1992; Musumeci et al., 1997), the ROS varies to subsequently change biophoton emission (Tsuchida et al., 2019). Induced changes in photon emissions offer physiologically relevant explanations for some human experiences that are often inexplicable even though not uncommon, including the entopic phenomena of phosphene and negative afterimage (Bokkon et al., 2011; Wang et al., 2011; Salari et al., 2017). Studies have also suggested that ROS may be signaling agents, rather than simply potential toxic agents (Rice et al., 2002). Whether ROS are signaling or toxic agents, the variation of the rate of the production of ROS in humans will be regulated ultimately by autonomic neuromodulation, which will likely differ at different stages of life and also be perturbed or affected by environmental factors and acquired conditions. Variations in biophoton emissions due to variations of ROS then shall be expected to follow the temporal paces as well as spatial patterns of the neuromodulating perturbation causing autonomic adaptation of ROS production, with a potential delay in the phase of change as is conceptualized in Figure 1.

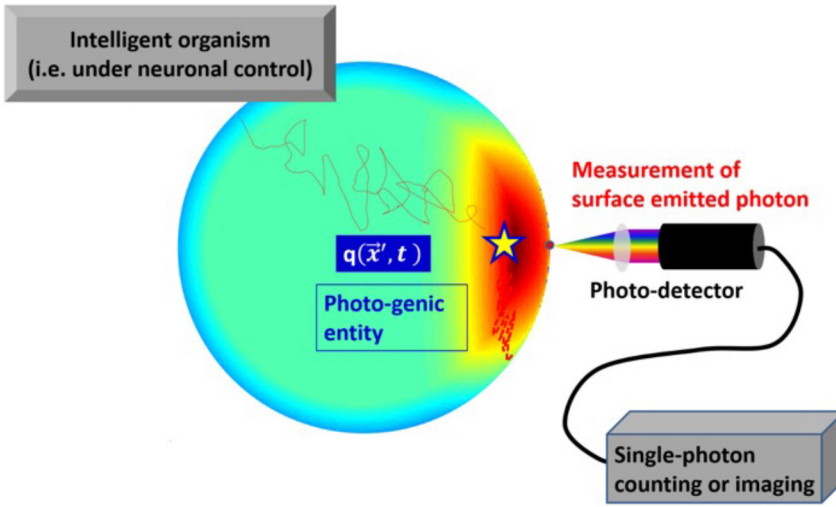


Figure 1. Conceptual illustration of the surface measurement of a biophoton from a human, representing a large intelligent organism. What is acquired by the photon-counting or imaging devices is the photons emitting from the surface of the organism. The origin of the surface-emitted biophotons may be at any location within human tissue, wherein a localized photo-genic entity engaging ROS may occur.

In this work, we propose an analytical framework of hypotheses with the objective to provide simple interpretations of a few somatic temporal and spatial patterns of spontaneous biophoton emission in humans, including the systemic dependency on age, the diurnal variation, and the geometric asymmetry associated with serious asymmetrical pathological conditions. The analysis speculates that there is a collective state of autonomic neuro-energy expressed in a form of "vivodensity," which in essence is the maximal coherence among the energy "modes" of neuronal control that an intelligent being represented by humans is able to engage in at any given time of life. This vivodensity could also be considered as being proportional to a chemical potential of the metabolic aspect (Piao, 2020b) which regulates how a systemic perturbation to metabolism is transferred to a local photo-genesis process to cause observable temporal changes in biophoton emission. This vivodensity thus is treated to modulate metabolic activities responsible for photo-genesis pertinent to biophotons. The hypothesis projects a decrease in the vivodensity

in humans during growth beyond puberty, with the rate of decrease dictated by a time constant set by the date of sexual maturity. The hypothesis also proposes a modification of the vivodensity by the phases of systemic or homeostatic physiology. The hypothesis further postulates that the deviation of the physiology-modified vivodensity from the pre-puberty level is deteriorated by acquired organ-specific pathological conditions. The temporal differential change of vivodensity is projected to be photo-genic, by proportionally modulating oxidative stress that functions as the physical source of biophoton emission. The age and systemic physiology combined determines the intensity of the physiological photo-genic source that is simplified as being centrally located within the body for analytical simplicity. An acquired pathology sets both the intensity and generally an off-center position of the pathological photo-genic source. The light emission from a photo-genic source, wherever it is within the tissue, then must diffuse through the human body in the process of propagating to the surface before being detected. The human tissue involved in biophoton propagation is treated as a homogeneous translucent spherical domain for analytical convenience. The diffusive photon propagation in tissue is modeled according to photon diffusion principles that account for scattering and absorption of bulk tissue and incorporates an extrapolated zero-boundary condition. When the age-commemorated, physiology-commanded, and pathology-controlled modifications of the photo-genic sources are implemented in the steady-state photon diffusion model, the steady-state photon-fluence rate at the surface of the human-simplifying spherical domain can reveal the patterns of intensity dependence upon age, variations corresponding to systemic physiology, and geometric asymmetry associated with significant asymmetric pathological conditions as reported in experimental spontaneous biophoton emission studies.

A HYPOTHESIS ON NEURO-MODULATED PHOTO-GENIC SOURCING OF BIOPHOTON EMISSION

The scope of this work is to offer alternative insights on some temporal and spatial patterns of biophoton emission in humans, which indubitably represents the highest level of intelligence among

organisms. We consider intelligence to be uniquely and ubiquitously associated with neuronal activity that ceases when the organism loses metabolic ability to excite or inhibit a neuronal firing. We represent the condition of a neuron with respect to its normal activated state (in either full excitatory or full inhibitory phase [Wilson & Cowan, 1972]) by a phasor term of

$$n_i(\vec{\chi}, t) = A(\vec{\chi}) \cdot exp[j\phi(t)] \tag{1}$$

where $i = [0, N_{total}]$ of which N_{total} is the total number of originally intact neurons. Denoting $N_{live}(t)$ as the number of viable neurons at a given time, we would have $N_{live}(t) \leq N_{total}$ due to neurodegeneration. Apparently, the proportion of the viable neurons with respect to the total number of originally intact neurons must be bounded in [0,1]. We choose a simple function to represent this dimensionless neuronal viability as the following

$$\eta_{viab}(t) = \frac{N_{live}(t)}{2N_{total} - N_{live}(t)} \tag{2}$$

The condition $\eta_{viab} = 1$ would indicate that all native neurons are intact, and $\eta_{viab} = 0$ would mark the complete death of the entire set of neurons. Note that Eq. (2) is not the exclusive form of η_{viab} in representing the proportion of viable neurons over the course of life. We further introduce a degree of coherence (dimensionless) to mark how well the neuronal activities are coordinated at a given time, as the following:

$$\xi_{cohe}(\vec{\chi}, t) = \prod_{n_1 \neq n_2}^{\vec{\chi}} \frac{\langle n_1^*(\vec{\chi} - \vec{x}_1, t) \cdot n_2(\vec{\chi} - \vec{x}_2, t + \tau) \rangle}{\sqrt{[n_1^*(\vec{x}_1, t) \cdot n_1(\vec{x}_1, t)] \cdot [n_2^*(\vec{x}_2, t) \cdot n_2(\vec{x}_2, t)]}} \tag{3}$$

where the $\langle \ldots \rangle$ of the numerator indicates temporal averaging. The $\vec{\chi}$ in the argument does not change the value of the time-averaging but will remain for a future need to address neuronal activities for regulating a specific metabolism. This $\xi_{cohe}(\vec{\chi}, t)$ also has a value of [0,1]. The condition of $\xi_{cohe} = 0$ indicates spontaneous neuronal activities that are completely random, while $\xi_{cohe} = 1$ marks the condition impossible

to reach with the activation of the entire set of neurons being exactly in-phase. We then hypothesize that the live state of a human can be treated as being associated with a collective state of autonomic neuro-control in a scale of "vivodensity," which has a spatially and temporally resolved scalar value of $\mathbb{E}_{vivo}(\vec{\chi}, t)$ (unit: $J \cdot cm^{-3}$) at a spatial position $\vec{\chi}$ and a time t. The scalar "vivodensity" $\mathbb{E}_{vivo}(\vec{\chi}, t)$ takes the following form:

$$\mathbb{E}_{vivo}(\vec{\chi}, t) = \eta_{viab}(t) \times \xi_{cohe}(\vec{\chi}, t) \times \mathbb{P}_{mode}(\vec{\chi}, t) \tag{4}$$

which includes a total mode-density $\mathbb{P}_{mode}(\vec{\chi}, t)$ (unit: $J \cdot cm^{-3}$)

represented by the following

$$\mathbb{P}_{mode}(\vec{\chi}, t) = \int \mathcal{P}(\vec{\chi}, t, \nu)\, d\nu \tag{5}$$

where $\mathcal{P}(\vec{\chi}, t, \nu)$ is a mode-distribution function at a frequency ν of neuron firing. The vivodensity $\mathbb{E}_{vivo}(\vec{\chi}, t)$ essentially defines the maximal coherence among the energy "modes" of neuronal control that an organism of intelligence is entitled to engage in. It can be expected that the ability of autonomic neuro-control degrades as an intelligent being ages, and the value represented by Eq. (4) shall decrease over age and recede to zero at the cease of the life. According to the declining survival rate of the human being as a function of age that becomes pronounced at older ages (Sarna et al., 1993), we regard the natural course from birth to death of human life to experience three systemic changes that may occur synchronously: (1) the initial healthy increase and later matured stabilization of the body volume-contents, (2) the temporal variation of the biological phases by endocrine and exocrine controls, and (3) the deterioration of the body functions due to acquired pathological conditions. We will then represent the course of change of $\mathbb{E}_{vivo}(\vec{\chi}, t)$ as

$$\mathbb{E}_{vivo}(\vec{\chi}, t) = \mathbb{Z}_{prim}(\vec{\chi}, t)\mathbb{H}_{syst}(\vec{\chi}, t)\left[1 - \mho_{path}(\vec{\chi}, t) \cdot \mathbb{N}_{auto}(\vec{\chi}, t)\right], \tag{6}$$

where $\mathbb{Z}_{prim}(\vec{\chi}, t)$ (unit: $J \cdot cm^{-3}$) denotes the "primo" state of

"vivodensity" inherited from birth, $\mathbb{H}_{syst}(\vec{\chi}, t)$ (unit: dimensionless) represents the phase of the systemic or homeostatic physiology that is endogenous to a healthy subject, $\mho_{path}(\vec{\chi}, t)$ (unit: dimensionless) accounts for the effect of an acquired pathology that is exogenous to an otherwise healthy subject, and $\mathbb{N}_{auto}(\vec{\chi}, t)$ (unit: dimensionless) marks the terminal autonomic control of the site pertinent to the acquired pathology. The basic declining behaviors of $\mathbb{E}_{vivo}(\vec{\chi}, t)$ from the "primo" level at birth due to aging and systemic physiology and acquired pathology are conceptualized in Figure 2. Panel (A) marks the initial level of "vivodensity" set at birth. Panel (B) specifies the decrease of "vivodensity" as a result of growth and aging. Panel (C) represents the deviation of "vivodensity" from the age-related level due to modulation by systemic physiology. Panel (D) manifests the degradation of "vivodensity" from the healthy level for a particular age caused by acquired pathology.

Additionally, there are the needs of several absolute time-points or characteristic ages of the course of natural human life that are symbolized as the following: t_{birth} is the time of birth, t_{death} is the time of death, t_{puber} is the time of puberty, so $\tau_{life} = t_{death} - t_{birth}$ is the life span and $\tau_{puber} = t_{puber} - t_{birth}$ is the age when puberty starts. At one's birth, the following initial conditions of the entities shall be relevant: $\mathbb{Z}_{prim}(\vec{\chi}, t_{birth}) = \mathbb{Z}_0$, $\mathbb{H}_{syst}(\vec{\chi}, t_{birth}) = 1$, and $\mho_{path}(\vec{\chi}, t_{birth}) = 0$ and $\mathbb{N}_{auto}(\vec{\chi}, t_{birth}) = 1$. The values of these parameters over the lifespan of the person for $t \in (t_{birth}, t_{death}]$ is further constrained respectively as the following:

$$\mathbb{Z}_{prim}(\vec{\chi}, t) \in [0, \mathbb{Z}_0], \mathbb{H}_{syst}(\vec{\chi}, t) \in (0,1], \mho_{path}(\vec{\chi}, t) \in [0,1]$$
$$\text{and } \mathbb{N}_{auto}(\vec{\chi}, t) \in [0,1].$$

A pathological condition that is terminal or lethal is represented by $\mho_{path}(\vec{\chi}, t) = 1$. A normal autonomic control of a site in a pathological condition is marked by $\mathbb{N}_{auto}(\vec{\chi}, t) = 1$. The complete loss of the autonomic control at the site of a pathological condition is demarcated by $\mathbb{N}_{auto}(\vec{\chi}, t) = 0$.

For the normal course of a human life, it is reasonable to assume that a life-shortening pathology is acquired after puberty, and the "primo" state of the vivodensity $\mathbb{Z}_{prim}(\vec{\chi}, t)$ from birth to puberty would be sustained at the initial level of $\mathbb{Z}_0$ set at birth with the

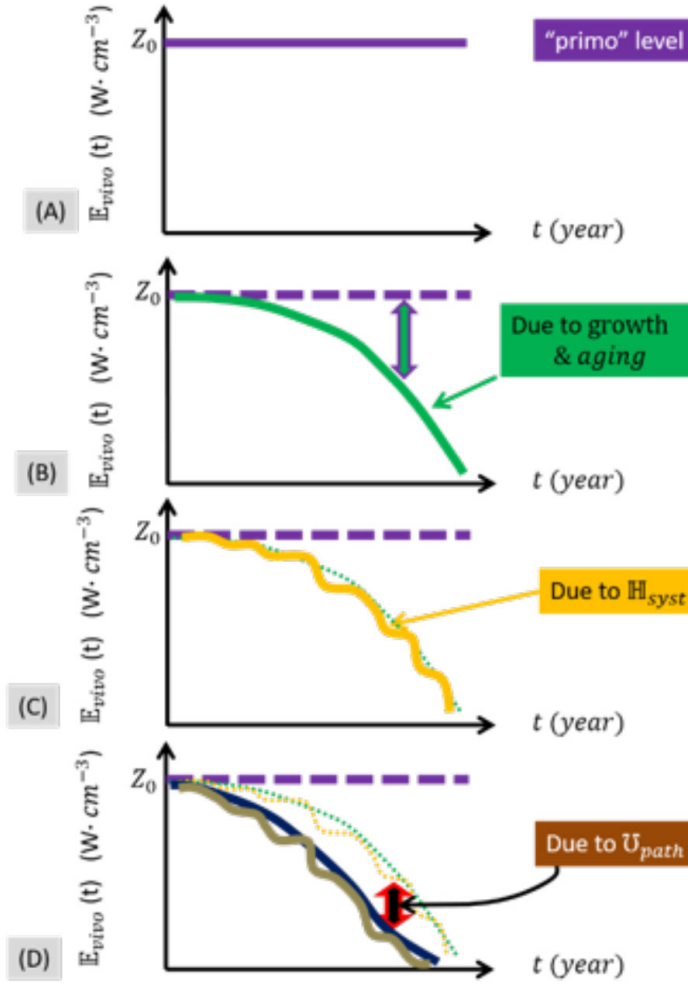


Figure 2. (A) The "vivodensity" bestowed on a person at birth. (B) The decrease of the vivodensity of a healthy person due to aging. (C) The modulation of the vivodensity of a healthy person by systemic physiology. (D) The degradation of the vivodensity of a person from the healthy level by acquired pathology.

only modification incurred due to systemic or homeostatic physiology $\mathbb{H}_{syst}(\vec{\chi}, t)$. This results in a level-set representation of the vivodensity as the following, with the use of the Heaviside or unit step function $u(t)$:

(7)

$$\mathbb{E}_{vivo}(\vec{\chi}, t) = \mathbb{Z}_0\big[u(t - t_{birth}) - u\big(t - t_{puber}\big)\big]\mathbb{H}_{syst}(\vec{\chi}, t) + \mathbb{Z}_{adol}(\vec{\chi}, t)\left[u\big(t - t_{puber}\big) - u(t - t_{death})\right]\mathbb{H}_{syst}(\vec{\chi}, t)\big[1 - \mho_{path}(\vec{\chi}, t)\mathbb{N}_{auto}(\vec{\chi}, t)\big]$$

where $\mathbb{Z}_{adol}(\vec{\chi},t)$ specifies the "primo" state of the vivodensity counted from τ_{puber} as the person enters "adolescence," which decreases from the "primo" level as the following:

$$\mathbb{Z}_{adol}(\vec{\chi},t)=\mathbb{Z}_0\{1-\boxtimes(\vec{\chi},t)\} \tag{8}$$

where $\boxtimes(\vec{\chi},t)\leq 1$ is a non-negative value corresponding to the amount of degradation of $\mathbb{Z}_{adol}(\vec{\chi},t)$ when compared to $\mathbb{Z}_0$. We define the temporal differential deviation of vivodensity from the systemic physiology modified birth state of $\mathbb{Z}_0$ over the lifetime as the following:

$$\frac{\partial}{\partial t}[\Delta\mathbb{Z}_{vivo}(\vec{\chi},t)]=\frac{\partial}{\partial t}\left[\mathbb{Z}_0\mathbb{H}_{syst}(\vec{\chi},t)-\mathbb{E}_{vivo}(\vec{\chi},t)\right] \tag{9}$$

By using Eq. (7), it is straightforward to obtain the following:

$$\begin{aligned}\frac{\partial}{\partial t}[\Delta\mathbb{Z}_{vivo}(\vec{\chi},t)]&=\langle\frac{\partial}{\partial t}\{[\mathbb{Z}_0-\mathbb{Z}_{adol}(\vec{\chi},t)]\mathbb{H}_{syst}(\vec{\chi},t)\}\rangle\left[u\left(t-t_{puber}\right)-u(t-t_{death})\right]\\&+\langle\frac{\partial}{\partial t}\{\mathbb{Z}_{adol}(\vec{\chi},t)\mathbb{H}_{syst}(\vec{\chi},t)\mathfrak{V}_{path}(\vec{\chi},t)\mathbb{N}_{auto}(\vec{\chi},t)\}\rangle\left[u\left(t-t_{puber}\right)-u(t-t_{death})\right]\end{aligned} \tag{10}$$

Two entities of differential properties are introduced as shown, respectively, in the following:

$$\frac{\partial}{\partial t}[\Delta\mathbb{Z}_{adol}(\vec{\chi},t)]=\mathbb{Z}_o\frac{\partial}{\partial t}\left[\boxtimes(\vec{\chi},t)\cdot\mathbb{H}_{syst}(\vec{\chi},t)\right] \tag{11}$$

$$\frac{\partial}{\partial t}\left[\Delta\mathbb{U}_{path}(\vec{\chi},t)\right]=-\mathbb{Z}_0\frac{\partial}{\partial t}\left[\boxtimes(\vec{\chi},t)\cdot\mathbb{H}_{syst}(\vec{\chi},t)\mathfrak{V}_{path}(\vec{\chi},t)\mathbb{N}_{auto}(\vec{\chi},t)\right] \tag{12}$$

Equation (9) then becomes

$$\begin{aligned}\frac{\partial}{\partial t}[\Delta\mathbb{Z}_{vivo}(\vec{\chi},t)]&=\left\{\frac{\partial}{\partial t}[\Delta\mathbb{Z}_{adol}(\vec{\chi},t)]\right.\\&\left.+\frac{\partial}{\partial t}\left[\Delta\mathbb{U}_{path}(\vec{\chi},t)\right]\right\}\left[u\left(t-t_{puber}\right)-u(t-t_{death})\right]\end{aligned} \tag{13}$$

where the first "differential" component associated with $\mathbb{Z}_{adol}(\vec{\chi},t)$

as specified by Eq. (11) denotes the temporal deviation of the "vivodensity" from the "primo" state as a result of normal biological development, and the second "differential" component associated with $\Delta\mathbb{U}_{path}$ as specified by Eq. (12) represents the further temporal deviation of the "vivodensity" from the normal level for a particular age due to acquired pathology.

Eq. (13) by referring to Eqs. (11) and (12) will infer the age-dependency of the temporal differentiation of $\mathbb{Z}_{vivo}$ by setting $\mathbb{H}_{syst}(\vec{\chi}, t) = 1$ and $\mathfrak{V}_{path}(\vec{\chi}, t) = 0$, the effect of systemic physiology over a time period by setting $\mathfrak{V}_{path}(\vec{\chi}, t) = 0$, and the outcome of acquired pathology at a given time point by setting $\mathbb{H}_{syst}(\vec{\chi}, t) = 1$.

We further hypothesize the vivodensity to be proportional to a chemical potential of the metabolic aspect (Piao, 2020b) which may regulate how a systemic perturbation to metabolism is transferred to a local photo-genesis process to cause observable temporal changes in biophoton emission, through the oxidative bio-chemical pathways that produce free radicals with ROS (Slawinski et al., 1992; Burgos et al., 2016). And this chain reaction can be treated as the changing rate of "vivodensity" that modulates oxidative stress. Integrating the spatially resolved temporal differentiation of the "vivodensity" changes represented by Eqs. (11) and (12) over the body-scaled volume gives rise to two spectrally and temporally resolved photo-genic intensity terms to be assigned as the sources of photo-genesis:

$$\mathbb{S}_{syst}(\lambda, t) = \varrho_{syst}(\lambda, t) \iiint \frac{\partial}{\partial t}[\Delta\mathbb{Z}_{adol}(\vec{\chi}, t)]\, d\vec{\chi}^3 \tag{14}$$

$$\mathbb{S}_{path}(\lambda, t) = \eth_{path}(\lambda, t) \iiint \frac{\partial}{\partial t}\left[\Delta\mathbb{U}_{path}(\vec{\chi}, t)\right] d\vec{\chi}^3 \tag{15}$$

where $\varrho_{syst}(\lambda, t)$(unit: cm^{-3}) is the spectrally and temporally resolved physiological-photogenic volumetric transfer-factor, and $\eth_{path}(\lambda, t)$ (unit: cm^{-3}) is the spectrally and temporally resolved pathological-photogenic volumetric transfer-factor. For simplicity, we treat the human body as a volume of spherical domain of radius R_0 as shown in Figure 3. The physiological photo-genic source $\mathbb{S}_{syst}$ (unit: $\mathbb{W} \cdot cm^{-3}$) is set at the center of the spherical domain, whereas the pathological photo-genic source $\mathbb{S}_{path}$ (unit: $\mathbb{W} \cdot cm^{-3}$) that may be

weighted for a single, serious, organ-specific pathology could be positioned at any distance R_{path} to the center. The spherical coordinates of the pathological photo-genic source $\mathbb{S}_{path}$ are set as $(\mathrm{R}_{path}, \theta', \phi')$, or for convenience of visualization at the 3 o'clock position with respect to the center of the spherical body. The spectral and temporal dependences of the photo-genic sources $\mathbb{S}_{syst}$ and $\mathbb{S}_{path}$ are not considered in this work, i.e.,

$$\varrho_{syst}(\lambda, t) = \varrho_{syst} = constant, \eth_{path}(\lambda, t) = \eth_{path} = constant,$$

thus $\mathbb{S}_{syst}$ and $\mathbb{S}_{path}$ are steady-state sources that will facilitate analysis of the simplest steady-state photon propagation in body volume.

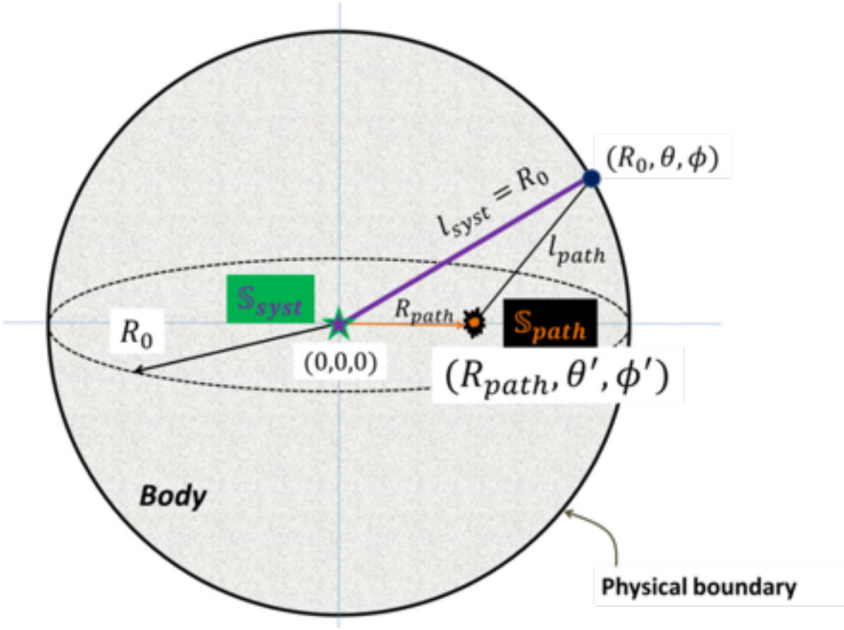


Figure 3. The human body is simplified as a geometric sphere with a radius R_0. The physiological photo-genic source $\mathbb{S}_{syst}$ is set at the center of the spherical domain, or with the spherical coordinates of (0,0,0). The pathological photo-genic source $\mathbb{S}_{path}$ is at $(\mathrm{R}_0, \theta, \phi)$ which is positioned at the 3 o'clock position with respect to the spherical center, at $(\mathrm{R}_{path}, 0, 0)$. The distance of any position on or off the spherical surface to the pathological source $\mathbb{S}_{path}$ is denoted as l_{path}.

NUMERICAL EVALUATION OF STEADY-STATE SURFACE PATTERNS OF BIOPHOTON EMISSION

We show in the Appendix how the steady-state diffusion of light with spectral relevancy to spontaneous biophoton emission (i.e., in the VIS/NIR band of the biological window for which the photon diffusion analysis is conventional) is treated with the necessary approximation to facilitate numerical evaluation of the problem in a spherical human-size tissue geometry with the pertinent boundary condition. In this section, we use the photo-genic terms of Eqs. (14) and (15) to illustrate the general bulk surface pattern, which manifests an aura-like hue, of steady-state biophoton emission.

Eq. (A13) (Appendix) can be implemented numerically to assess the patterns of steady-state photon-fluence rate presenting at or beyond the air-interfacing boundary of the human-representing spherical homogeneous tissue domain, in association with the physiological photo-genic source $\mathbb{S}_{syst}$ alone or with the addition of the pathological photo-genic source $\mathbb{S}_{path}$. The distribution of the steady-state photon-fluence rate across the surface of the human-representing spherical domain and expanding to the extrapolated zero-boundary is exemplified in Figure 4. The tissue medium used for all numerical evaluations in this section is specified with the following dimensional and optical properties: a radius of $R_0 = 10\ \mathrm{cm}$, an absorption coefficient of $\mu_a = 0.1\ \mathrm{cm}^{-1}$, a reduced scattering coefficient of $\mu_s' = 10\ \mathrm{cm}^{-1}$, and a refractive index of $n = 1.4$. The tissue optical properties result in a distance of $R_b = 0.11\ cm$ of the extrapolated zero-boundary from the tissue boundary, which is only 1.1% of the radius of the spherical domain. When the tissue medium represented by the spherical domain contains only the centered physiological photo-genic source $\mathbb{S}_{syst}$, the photon-fluence rate on the entire spherical boundary has to be circumferentially uniform, and the photon-fluence rate will decrease from the tissue boundary to become zero at the extrapolated zero-boundary. The degradation of the steady-state photon-fluence rate from the tissue boundary to the extrapolated zero-boundary over an entire azimuthal or elevational circle will appear as a thin circular strip (i.e., aura-like hue) of 0.11 cm thick around the spherical tissue domain. To better visualize this thin circular strip of the

steady-state photon-fluence rate around the spherical tissue domain in Figure 4, the evaluation of Eq. (A13) over the space beyond the tissue boundary is conducted over a radial distance of 10 times of R_b, i.e., a 1.1-cm distance from the tissue boundary as the strip of lower color value outside the dashed circle demarcating the spherical tissue boundary. In obtaining Figure 4, the following additional parameters are necessary: $\mathbb{S}_{syst} = 0.01\mu W \cdot \mathrm{cm}^{-3}$ a n d $\mathbb{S}_{path}$ = o. The circumferentially uniform photon-fluence rate across the spherical tissue domain represents the 2-dimentional projection of the photon-fluence rate measured on the surface of the spherical tissue domain, as is the case for measurement/imaging using a planar, pixelated photon-detection device. The steady-state photon-fluence rate projected on the surface of a spherical tissue domain of the associated optical properties with a 10-cm radius and an extremely weak source of $0.01\mu W \cdot \mathrm{cm}^{-3}$ at the center is at the level of $1 \times 10^{-17} W \cdot \mathrm{cm}^{-2}$ (corresponding to 25

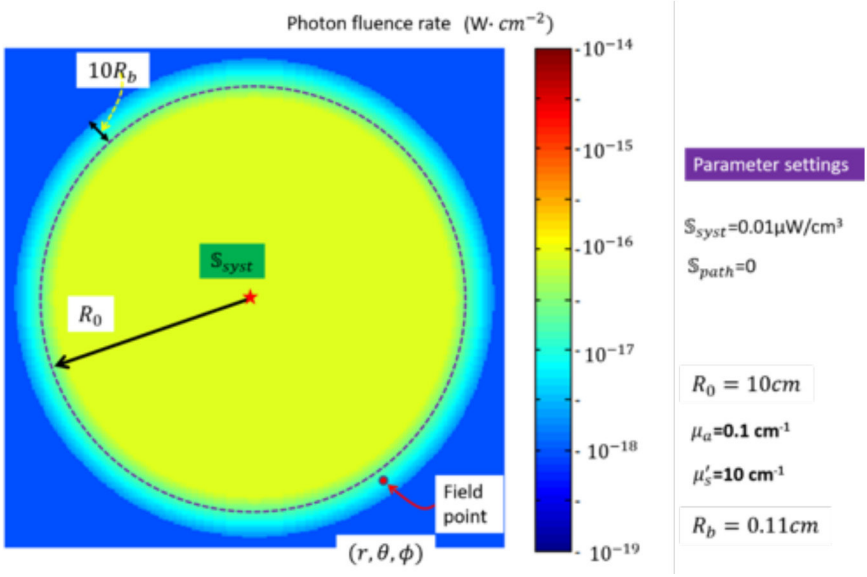


Figure 4. Example of the distribution of the photon-fluence rate across the surface of the human-representing spherical domain and expanding to the extrapolated boundary. The degradation of the photon-fluence rate from the tissue boundary to the extrapolated boundary over an entire azimuthal or elevational circle is illustrated as a thin circular strip around the spherical tissue domain.

counts of 500 nm photons per second per cm^2), and drops to zero at the extrapolated zero-boundary that in actual scale is just about 0.11 cm or 1.1 mm away from the tissue boundary of the specified optical properties. A smaller difference of the refractive index between tissue and air could push the extrapolated zero-boundary away from the tissue to make the hue-like margin broader.

ASSIMILATION OF SOMATIC TEMPORAL AND SPATIAL PATTERNS OF BIOPHOTON EMISSION

In the following sections, we demonstrate how the temporal and spatial patterns of biophoton emission measured on the surface of the spherical domain can be modulated by modulating the photo-genesis to reveal some global or somatic patterns that have been shown to be associated with the activities of intelligent beings including human and rodent models of human disease.

The numerical implementations of Eq. (A13) are configured in three different cases of the photo-genic sources that all change at rates that are extremely slow compared with the time of photon propagation in tissue. This will result in the temporal pace of the surface photon emission to be dictated by the temporal pattern of photo-genesis that may be further modified by the spatial configuration of photo-genesis with respect to the surface measurement (Piao, 2020a). The following analyses will reveal, respectively, the most apparent superficial temporal and spatial patterns of age-dependency, physiological variation, and pathological asymmetry of the steady-state photon-fluence rate at the surface of the spherical domain. It is noted that the macroscopic temporal variation is assessed via relative changes of the steady-state photon-fluence rate evaluated at the same spatial location over a macroscopic timescale that is many orders greater than the time of light propagation in the tissue domain. Therefore, when the steady-state photon-fluence rate is to be evaluated at one position to assess the temporal changes at any macroscopic duration, the position of the field point is set at the spherical tissue boundary and at the 3 o'clock position, and the resulting steady-state photon-fluence rate is normalized by comparing with data from the literature of spontaneous steady-state biophoton emission that are reproduced with the copyrighters' permissions.

Presentation of Age Dependency

In order to simulate age dependency, it is necessary to specify the timescale characteristics of physiological photo-genesis. We define τ_{fossi} as the age of a person's first opposite-sex sexual intercourse (FOSSI). A person who commits heterosexual activities at least once in their life will have $t_{birth} < t_{puber} < (t_{birth} + \tau_{fossi}) < t_{death}$. A person who remains a virgin will have $\tau_{fossi} = (t_{death} - t_{birth}) = \tau_{life}$ We define the systemic photo-genesis of biophoton emission as a result of aging to take the following form

$$\mathbb{S}_{syst}(\lambda, t) = \left[1 - exp\left(-\frac{t}{\tau_{age}}\right)\right]^{\alpha} \tag{16}$$

where the time constant τ_{age} takes a slowly reducing form represented by the following

$$\tau_{age}=(\tau_{life} - \tau_{fossi})\exp\left[-\frac{(t-t_{puber})*H(t-t_{puber})}{\tau_{fossi}}\right]+ \tau_{fossi} \tag{17}$$

where *a* is a positive number or an aging factor. The age dependency and gender difference of the photon-fluence rate at the boundary of the spherical tissue domain is simulated by removing $\mathbb{S}_{path}$ and setting the following parameters: the puberty age t_{puber} of males is 13, the puberty age t_{puber} of females is 11, the FOSSI age τ_{fossi} of both males and females is age 20, the aging factor is specified as *a* = 2, and a lifespan is 75 years. The male tissue density is assumed to be greater than the female at the same age, leading to stronger intensity of the physiological photo-genic source $\mathbb{S}_{syst}$ for males at otherwise identical settings of the parameters. Alternatively, stronger adipose fat content in females could cause a higher scattering attenuation of the photon propagation to result in less photon emission at the surface of the body under the same physical dimensions and photo-genic conditions. A literature report showing the dependency of spontaneous biophoton counts on age and the difference in biophoton counts between males and females is reproduced with permission from the publisher (He et al., 2016) as shown in Figure 5A. In panel (A) there is a smaller downward-pointing arrow pointing to an age group of 11 to 14 years for both males and females, at which the biophoton count starts

to increase noticeably. That age range is projected to indicate puberty. In panel (A) there is a larger upward-pointing arrow pointing to an age group of 41 to 50 years for the female group that may be interpreted as menopause onset. That menopause-inferring change is not included in the numerical model analysis per se. The numerical results as specified heretofore are plotted in Figure 5(B) with the assumption that the photon-fluence rate has a baseline count at the same levels as in the literature report.

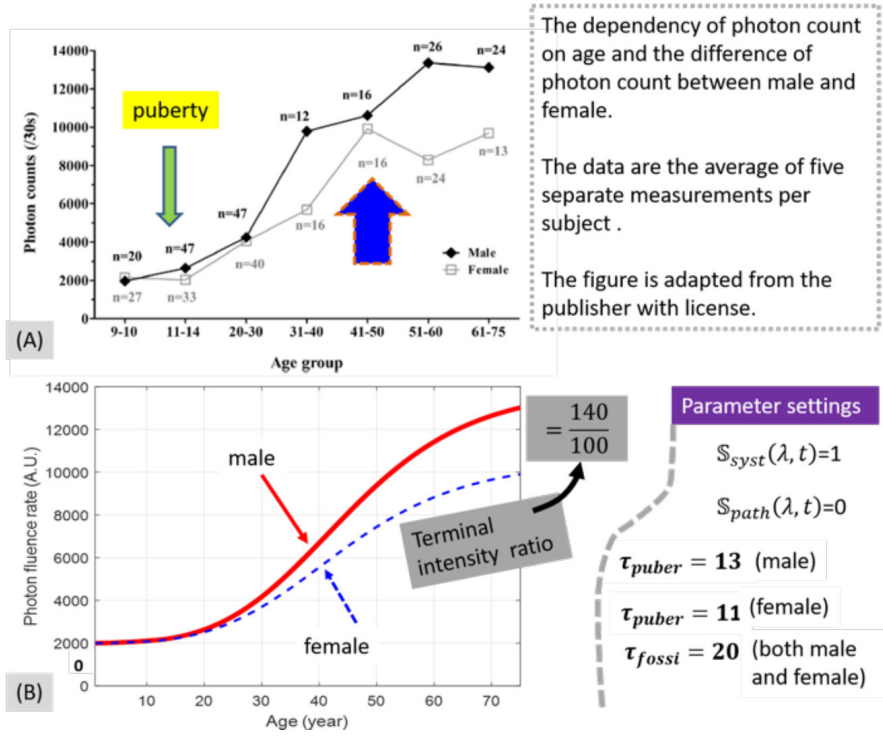


Figure 5. (A) The age dependency and gender difference in biophoton emission, demonstrated in a literature study (He et al., 2016), and (B) the simulated photon-fluence rate at the boundary of the spherical tissue. In panel (A), the small arrow (pointing downward) pointing toward age group 11–14 for both males and females, is the point at which the spontaneous biophoton count started to increase noticeably. That age group is projected to indicate puberty. In (A), the larger upward-pointing arrow points to the female age group 41–50 and may be interpreted as indicating menopause onset.

Presentation of Diurnal Variation

The variation of the photon fluence rate revealed at the boundary of the spherical tissue domain as a function of short-term homeostatic changes over a duration of 24 hours is simulated by removing $\mathbb{S}_{path}$ and setting $\mathbb{H}_{syst}$ and thus $\mathbb{S}_{syst}(\lambda, t)$ to change periodically.
A known diurnal variation of the spontaneous biophoton count is adopted from an open access publication (Cifra et al., 2007) as shown in Figure 6(A). The spontaneous biophoton emission intensity revealed a trough in the later afternoon and a peak in early

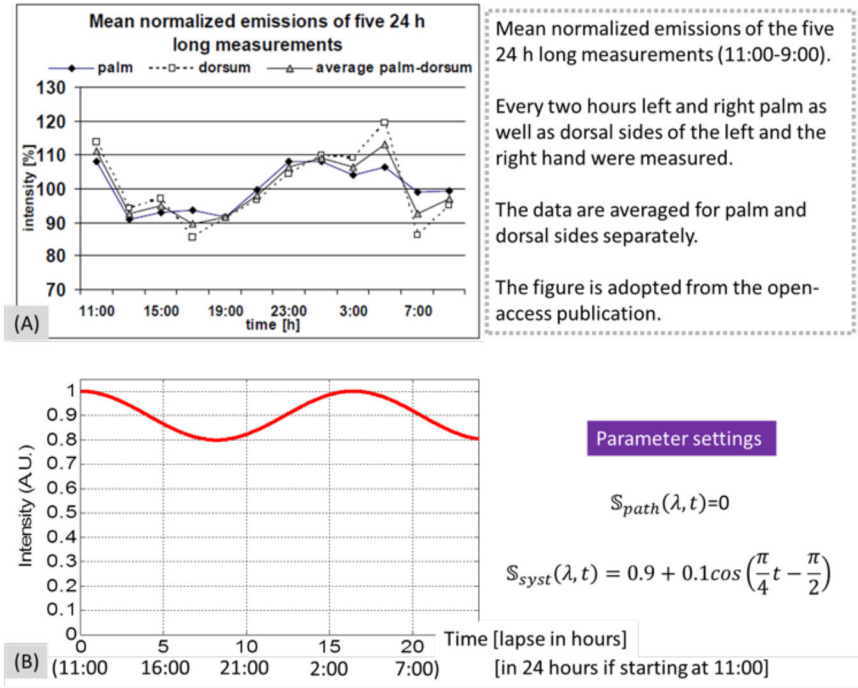


Figure 6. (A) The diurnal variation of biophoton counts adopted from Cifra et al. (2007). The biophoton emission intensity revealed a trough later in the afternoon and a peak in the early morning. That diurnal variation over a range of approximately 90–110% of the mid-line level can be directly associated with the circadian cycle. The variation of the photon-fluence rate revealed at the boundary of the spherical tissue domain as a function of short-term homeostatic changes is simulated by removing $\mathbb{S}_{path}$ and setting $\mathbb{S}_{syst}$ to change periodically. The circadian cycle is implemented into the intensity of the physiological photo-genic source in Eq. (13) by setting $\mathbb{S}_{syst}(\lambda, t) = 0.9 + 0.1cos\left(\frac{\pi}{4}t - \frac{\pi}{2}\right)$.

morning. That diurnal variation over a range of approximately 90–110% of the mid-line level can be directly attributed to the circadian cycle. The circadian cycle is thus implemented into the intensity of the physiological photo-genic source in Eq. (A13) by setting $\mathbb{S}_{syst}(\lambda, t) = 0.9 + 0.1cos\left(\frac{\pi}{4}t - \frac{\pi}{2}\right)$. This circadian-like systemic change results in $\mathbb{S}_{syst}(\lambda, t)$ oscillating between 1 and 0.8. The resulting photon-fluence rate as shown in Figure 6(B) varies at a cycle close to that manifested by the noisier presentation shown in panel (A).

Presentation of Spatial Asymmetry Associated with an Asymmetric Pathological Condition

The spatial asymmetry of the surface photon-fluence rate can be induced by placing a pathological photo-genic source off-center in the spherical domain. Such a possibility is demonstrated in Figure 7 in referencing the asymmetric spontaneous biophoton emission intensity that became aggregated as the tumor-load at the right axillary of a breast cancer mouse model increased (reproduced with permission from the publisher) (Zhao et al., 2017). The tumor volume is modeled as increasing exponentially (Jiang et al., 2011). The tumor volumes of respectively less than 0.5 cm in diameter, between 1 cm and 1.5 cm in diameter, and greater than 1.5 m in diameter as specified on panel (A) are modeled as $\exp\left(\frac{1}{1.5}\right)$, $\exp\left(\frac{2}{1.5}\right)$, and $\exp\left(\frac{3}{1.5}\right)$ as plotted on panel (B). The resulting numerical value of the tumor size is scaled down to 1% and used as the intensity of the pathological photo-genic source $\mathbb{S}_{path}$ that is placed at 1 cm off-center at the right-lateral aspect and 1 cm off-center at the right anterior aspect, as illustrated in the left column of panel (C). In comparison, the centered physiological photo-genic source $\mathbb{S}_{syst}$ is set to have an intensity of 1. The intensity ratios of the centered physiological photo-genic source $\mathbb{S}_{syst}$ over the slightly off-centered pathological photo-genic source $\mathbb{S}_{path}$ for the three sizes of the tumor load are thus respectively 1 vs. 0.0195, 1 vs 0.0379, and 1 vs. 0.739. The resulting photon fluence rate over the surface of the spherical tissue domain that is projected onto the middle cross-section and surrounded by a thin strip of the space beyond the tissue boundary is presented in the middle column of panel (C). The left–right asymmetry of the surface photon-fluence rate becomes

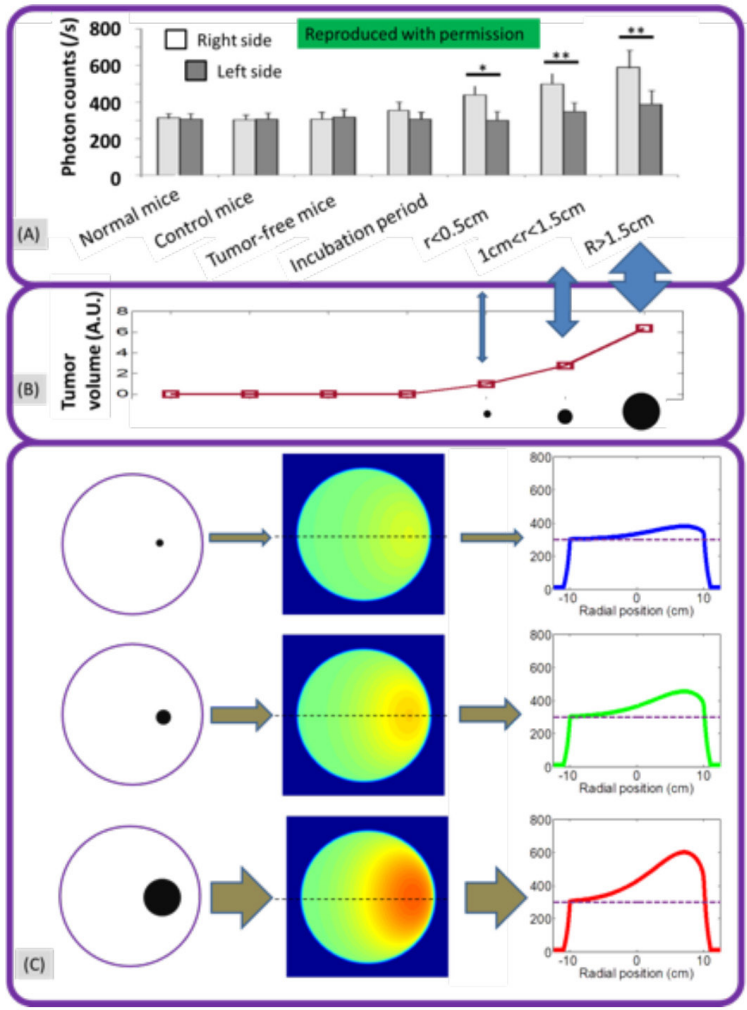


Figure 7. (A) The asymmetric biophoton emission intensity that became aggregated as the tumor-load at the right axillary of a breast cancer mouse model increased (Zhao et al., 2017). The tumor volumes of, respectively, < 0.5 cm in diameter, between 1 cm and 1.5 cm in diameter, and greater than 1.5 cm in diameter as specified on panel (A) are scaled as $\exp\left(\frac{1}{1.5}\right)$, $\exp\left(\frac{2}{1.5}\right)$, and $\exp\left(\frac{3}{1.5}\right)$ as plotted on panel (B). The resulting numerical value of the tumor size is scaled to 1% and used as the intensity of the pathological photo-genic source $\mathbb{S}_{path}$ that is placed at 1 cm off-center at the right-lateral aspect and 1 cm off-center at the right anterior aspect, as illustrated in the left column of panel (C). The resulting photon-fluence rate over the surface of the spherical tissue domain that is projected to the middle cross-section and surrounded by a thin strip of the space beyond the tissue boundary is presented in the middle column of panel (C). The 1-dimensional profile along the diameter crossing the 9 o'clock position to the 3 o'clock position of the 2-dimensional photon-fluence rate map of the middle column of panel (C) is given at the right column of panel (C).

pronounced as the localized pathological photo-genic source increases in intensity. The 1-dimensional profile along the diameter crossing the 9 o'clock position to the 3 o'clock position of the 2-dimensional photon-fluence rate map of the middle column of panel (C) is given at the right column. For a baseline arbitrary photon-fluence rate of 300 over the tissue domain that is least affected by the pathological photo-genic source, the global change of the maximal photon-fluence rate in the right lateral region of the side of the pathological photo-genic source increases from the baseline level to approximately 600. The pattern of the photon-fluence rate at the right lateral side is similar to that of the literature pattern of spontaneous biophoton emission shown on panel (A). Meanwhile, the maximal photon-fluence rate in the contra-lateral aspect of the pathological photo-genic source has increased slightly from the baseline, as the left–right difference becomes pronounced. This pattern of slight change of the contra-lateral normal side can also be associated with the spontaneous biophoton emission pattern shown on panel (A).

DISCUSSION

This work is intended to initiate a quantitative model-based interpretation of a few superficial patterns of steady-state spontaneous biophoton emission in humans to model human disease of holistic concern. These patterns of biophoton emission have presented associations with age, systemic physiology, and localized pathological conditions. An obvious limitation of the proposed approach is the unresolved problem regarding the exact physical mechanism of autonomic regulation of biophoton emission which, unfortunately, is prohibitive to answer and thus remains to be speculated upon at the current stage. As a result, the proposed model only simulates the general life processes from a macro perspective, by including birth, sexual maturity, aging, and possible significant pathological states of human beings as the macroscopic factors influencing the origin of biophoton emission through an oxidative stress pathway that could be influenced by autonomic neuromodulation. In addition, the contribution of organs to oxidative stress as the chemical source of photo-genesis is complex and thus discourages the simple expression of its translation

to the (single) source of biophoton emission, even though the model could serve as a starting intuitive platform that can be augmented with more complexity of the disease model in the context of photo-genesis. Another apparent limitation of this model is the arbitrary valuing of the photo-genic factor for converting the hypothetical differential change of the vivodensity to a physical source of light emission. The photo-genic factor could not be specified unless the hypothetical alternative state of the energy scaled as "vivodensity" can somehow be examined. Another limitation is the modeling of the human tissue volume as a translucent and homogeneous spherical domain, even though it perhaps be more realistic than the more commonly treated semi-infinite tissue domain. Human tissue is also extremely heterogeneous concerning photon propagation. The advantage of the present spherical tissue domain is the involvement of only one boundary, as the geometry involves essentially a radial dependency. A more practical geometry of representing human tissue volume in terms of photon propagation may be a cylindrical domain of finite-length within which the similar photon diffusion approach can be applied, and in which the heterogeneity in tissue optical properties for photon propagation can be included. Applying the photon diffusion approach to a finite-length cylindrical tissue domain would also require considering the boundary at two orientations, one along the radial dimension and the other along the polar aspect. That treatment may reveal that the strips of photon emission at the cranial and caudal aspects of the human body differ from the strips of photon emission at the lateral aspects of the human body (Van Wijk et al., 2014), a presentation that may have interesting implications for bioenergy practices. Treating heterogeneous tissue optical properties will incur considerably more complex treatment than is dealt with in this present work.

In this work, the physiological photo-genic source is hypothesized to be located at the center of the human tissue domain and concerns the systemic influence of any homeostatic causes governed by autonomic responses. Additionally, the localization of the pathological photo-genic causes at only one off-center source is rather arbitrary. But the results associated with a single off-center pathological photo-genic source can be conveniently expanded to the case of having multiple pathological conditions that each demands an individual photo-genic

source or a cluster of sources that can be weighted according to the tissue mass or volume affected. In such cases, multiple pathological photo-genic sources of different intensities (and different temporal presentations) can be localized at different positions that potentially represent their site-specific anatomy, and the spatially resolved photon-fluence rates resulting from those multiple pathological photo-genic sources can be combined in perhaps a linear format to inform the composite photon-fluence rate at the surface, and further configured in three dimensions for tomography or topography needs. For a more complicated tissue geometry and tissue with heterogeneous optical properties, the computation of the surface photon-fluence rate may be conducted by using numerical procedures such as finite-element methods (FEM) (Arridge et al., 2000) for solving photon propagation problems. Implementing numerical methods such as FEM may also allow addressing complicated pathological photo-genic causes that are better represented by the source modeled over a continuous tissue volume of arbitrary shapes or extents if they all contribute to the hypothetical photo-genesis through the oxidative stress process that ultimately involves autonomic control.

The pathological condition has been hypothetically linked in this model with neuronal control in deriving the photo-genic source term. A site of pathology that has lost autonomic control will likely lead to no change of the vivodensity, and thus a smaller or zero intensity of the photon-genic source. A smaller photo-genic source will result in a smaller superficial photon-fluence rate at the geometric side of the pathological condition, or equivalently higher superficial photon-fluence rate at the contra-lateral side. This arrangement of autonomic control has made the model output consistent with the observation of lower spontaneous biophoton emission at the hand of hemiparesis when compared with the normal contra-lateral hand (Jung et al., 2003). The validity of the photo-genic effect of autonomic control for the superficial patterns of spontaneous biophoton emission is subject to experimental examinations.

The macroscopic-scale temporal changes of the superficial photon-fluence rate have been estimated in this work for a single case of diurnal-like variation over a short 24-hour period. The approach is applicable, however, to modeling macroscopically presented, temporal

changes over a timescale much different from a day-long period. In order to evaluate the temporal changes of the superficial photon fluence rate over a longer-than-a-day scale, we will need to know how the homeostatic changes over the same timescale may alter the physiological photo-genic process. The methodological conveniences of estimating the macroscopic-scale superficial photon-fluence rate, on the other hand, may facilitate modeling the microscopic-scale temporal pattern of biophoton emission under short and strong stimulation or stress. This will require treating the photon diffusion problem as a strictly temporal problem with fast time-responses, not the steady-state problem with slower temporal modulation of the photo-genic source as is simplified in this part of the work for superficial profiling of steady-state spontaneous biophoton emission. Works based on time-domain photon propagation approaches have been demonstrated by the author to address the kinetics of the changes of biophoton emission induced by external stress that exerts significantly faster modulation to the photo-genesis (Piao, 2020a; Piao, 2020b). The theoretical outcomes of those works agree with what others have observed (Chwirot, 1988; Hagens et al., 2008) and seem to support the central hypothesis of this work.

We note that, regardless of the complexity of model approaches to explain biophoton phenomena appearing to co-exist in humans, it may become unavoidable to consider human factors in addressing the observations. And consideration of human factors will likely be plausible by implementing neuronal activities as a source of modulating biological responses that will determine the physical origin of biophoton emission, or the variation of biophoton emission as a result of external conditions. Since neuronal activities give rise to bioelectrical signals, assessing the neuro-electrical signals synchronously with the registration of any changes in biophoton emissions in humans, or a faculty of neuronal control, may provide unprecedented insights into the mechanism of biophoton emission and inter-neural communication.

CONCLUSIONS

In conclusion, we have presented an analytical hypothesis for the interpretation of a few patterns of steady-state spontaneous biophoton emission in humans, including the dependency on age,

diurnal variation, and the geometric asymmetry associated with serious asymmetrical pathological conditions. The hypothesis has assumed a collective state of autonomic neuro-energy expressed as vivodensity, which is considered to be associated with only metabolically active organisms that are also under neuronal control. This vivodensity represents the maximal coherence among the energy "modes" of neuronal control that an intelligent being represented by humans is entitled to engage in at a given time of life. This vivodensity is linked to modulating metabolic activities responsible for photo-genesis pertinent to biophoton emission. The hypothesis projects a decrease of vivodensity in humans during growth beyond puberty, with the rate of decrease dictated by a timescale set by the date of sexual maturity. The hypothesis also projects a modification of the vivodensity by the phases of systemic or homeostatic physiology. The hypothesis further postulates that the deviation of the physiology-modified vivodensity from the pre-puberty level is deteriorated by acquired organ-specific pathological conditions. A temporal differential change of vivodensity is hypothesized to ultimately cause the variations in oxidative stress that have been known to be a primary physical source of biophoton emission. The human geometry model is simplified as a homogeneous spherical domain. The resulting steady-state diffusion of the photon emitted from a photo-genic source in the human geometry model is modeled by steady-state photon diffusion incorporating an extrapolated zero-boundary condition. The physiological photo-genic source is centered, and its intensity is determined by the age and systemic physiology combined. Comparatively, an acquired asymmetric pathology sets both the intensity and the off-center position of the pathological photo-genic source. When the photo-genic sources are implemented in the photon diffusion model, the steady-state photon-fluence rate at the surface of the simplified human-representing spherical domain resembles the superficially presented patterns of age-dependency, homeostatic variation, and pathology-induced asymmetry of spontaneous biophoton emission reported in experimental studies. The analytical method has had the applicability demonstrated in a time-domain analysis, for interpreting the delayed-emission kinetics of biophoton emission under stimulation.

REFERENCES

Arridge, S. R., Dehghani, H., Schweiger, M., & Okada, E. (2000). The finite element model for the propagation of light in scattering media: A direct method for domains with nonscattering regions. *Medical Physics, 27*(1), 252–264. https://doi.org/10.1118/1.598868

Bókkon, I., Salari, V., Tuszynski, J. A., & Antal, I. (2010). Estimation of the number of biophotons involved in the visual perception of a single-object image: Biophoton intensity can be considerably higher inside cells than outside. *Journal of Photochemistry and Photobiology B: Biology, 100*(3), 160–166. https://doi.org/10.1016/j.jphotobiol.2010.06.001

Bókkon, I., Vimal, R. L. P., Wang, C., Dai, J., Salari, V., Grass, F., & Antal, I. (2011). Visible light induced ocular delayed bioluminescence as a possible origin of negative afterimage. *Journal of Photochemistry and Photobiology B: Biology, 103*(2), 192–199. https://doi.org/10.1016/j.jphotobiol.2011.03.011

Boveris, A., Cadenas, E., Reiter, R., Filipkowski, M., Nakase, Y., & Chance, B. (1980). Organ chemiluminescence: Noninvasive assay for oxidative radical reactions. *Proceedings of the National Academy of Sciences USA, 77*(1), 347–351. https://doi.org/10.1073/pnas.77.1.347

Boveris, A., Puntarulo, S. A., Roy, A. H., & Sanchez, R. A. (1984). Spontaneous chemiluminescence of soybean embryonic axes during imbibition. *Plant Physiology, 76*(2), 447–451. https://doi.org/10.1104/pp.76.2.447

Burgos, R. C., Cervinková, K., van der Laan, T., Ramautar, R., van Wijk, E. P. A., Cifra, M., Koval, S., Berger, R., Hankemeier, T., & van der Greef, J. (2016). Tracking biochemical changes correlated with ultra-weak photon emission using metabolomics. *Journal of Photochemistry and Photobiology B: Biology, 163*, 237–245. https://doi.org/10.1016/j.jphotobiol.2016.08.030

Cadenas, E. (1984). Biological chemiluminescence. *Photochemistry and Photobiology, 40*(6), 823–830. https://doi.org/10.1111/j.1751-1097.1984.tb04657.x

Cadenas, E., Boveris, A., & Chance, B. (1980). Low-level chemiluminescence of bovine heart submitochondrial particles. *Biochemical Journal, 186*(3), 659–667. https://doi.org/10.1042/bj1860659

Caswell, J. M., Dotta, B. T., & Persinger, M. A. (2014). Cerebral biophoton emission as a potential factor in non-local human-machine interaction. *NeuroQuantology, 12*(1), 1–11. https://doi.org/10.14704/NQ.2014.12.1.713

Chwirot, W. B. (1988). Ultraweak photon emission and anther meiotic cycle in Larix europaea (experimental investigation of Nagl and Popp's electromagnetic model of differentiation). *Experientia, 44*(7), 594–599. https://doi.org/10.1007/BF01953307

Cifra, M., & Pospišil, P. (2014). Ultra-weak photon emission from biological samples: Definition, mechanisms, properties, detection and applications. *Journal of Photochemistry and Photobiology B: Biology, 139*, 2–10. Cifra, M., van Wijk, E., Koch, H., Bosman, S., & Van Wijk, R. (2007). Spontaneous ultra-weak photon emission from human hands is time dependent. *Radioengineering, 16*(2), 15–19. https://doi.org/10.1016/j.jphotobiol.2014.02.009

Cohen, S., & Popp, F. A. (1997). Biophoton emission of the human body. *Journal of Photochemistry and Photobiology, Biology B: Biology, 40*(2), 187–189. https://doi.org/10.1016/S1011-1344(97)00050-X

Cohen, S., & Popp, F. A. (2003). Biophoton emission of human body. *Indian Journal of Experimental Biology, 41*(5), 440–445.

Contini, D., Martelli, F., & Zaccanti, G. (1997). Photon migration through a turbid slab described by a model based on diffusion approximation. I. Theory. *Applied Optics, 36*(19), 4587–4599. https://woi.org/10.1364/ao.36.004587

Devaraj, B., Usa, M., & Inaba, H. (1997). Biophotons: Ultraweak light emission from living systems. *Current Opinion in Solid State & Materials Science 2*(2), 188–193. https://doi.org/10.1016/S1359-0286(97)80064-2

Fedorova, G. F., Trofimov, A. V., Vasil'ev, R. F., & Veprintsev, T. L. (2007). Peroxy-radical-mediated chemiluminescence: Mechanistic diversity and funda-mentals for antioxidant assay. *Arkivoc, 8*, 163–215. https://doi.org/10.3998/ark.5550190.0008.815

Gallas, J. M., & Eisner, M. (1987). Fluorescence of melanin–dependence upon excitation wavelength and concentration. *Photochemistry and Photobiology, 45*(5), 595–600. https://doi.org/10.1111/j.1751-1097.1987.tb07385.x

Hagens, R., Khabiri, F., Schreiner, V., Wenck, H., Wittern, K.-P., Duchstein, H.-J., & Mei, W. (2008). Non-invasive monitoring of oxidative skin stress by ultraweak photon emission measurement. II: Biological validation on ultraviolet A-stressed skin. *Skin Research and Technology, 14*(1), 112–120. https://doi.org/10.111/j.1600-0846.2007.00207.x

Haraguchi, S., Kotake, J., Chen, W., Parkhomtchouk, D. V., Zhang, T., & Yamamoto, M. (2001). Biophoton change by mental concentration. *Journal of International Society of Life Information Science, 19*(2), 373–380.

Haskell, R. C., Svaasand, L. O., Tsay, T. T., Feng, T. C., McAdams, M. S., & Tromberg, B. J. (1994). Boundary conditions for the diffusion equation in radiative transfer. *Journal of the Optical Society of America, A: Optics, Image Science, and Vision, 11*(10), 2727–2741. https://doi.org/10.1364/josaa.11.002727

Havaux, M., Triantaphylidès, C., & Genty, B. (2006). Autoluminescence imaging: A non-invasive tool for mapping oxidative stress. *Trends in Plant Science, 11*(10), 480–484.

He, M., Sun, M., van Wijk, E., van Wietmarschen, H., van Wijk, R., Wang, Z., Wang, M., Hankemeier, T., & van der Greef, J. (2016). A Chinese literature overview on ultra-weak photon emission as promising technology for studying system-based diagnostics. *Complementary Therapies in Medicine, 25*, 20–26. https://doi.org/10.1016/j.ctim.2015.12.015

Ishimaru, A. (1989). Diffusion of light in turbid material. *Applied Optics, 28*(12), 2210–2215. https://doi.org/01.1364/AO.28.002210

Ives, J. A., van Wijk, E. P. A., Bat, N., Crawford, C., Walter, A., Jonas, W. B., van Wijk, R., & van der Greef, J. (2014). Ultraweak photon emission as a non-invasive health assessment: A systematic review. *PLoS One 9*(2), e87401. https://doi.org/10.1371/journal.pone.0087401

Jiang, Z., Piao, D., Bartels, K. E., Holyoak, G. R., Ritchey, J. W., Ownby, C. L., Rock, K., & Slobodov, G. (2011). Transrectal ultrasound-integrated spectral optical tomography of hypoxic progression of a regressing tumor in a canine

prostate. *Technology in Cancer Research & Treatment, 10*(6), 519–531. https://doi.org/10.1177/1533034611010006O3

Joines, W. T., Baumann, S. B., & Kruth, J. G. (2012). Electromagnetic emission from humans during focused intent. *Journal of Parapsychology, 76*(2), 275–294.

Jung, H.-H., Woo, W.-M., Yang, J.-M., Choi, C., Lee, J., Yoon, G., Yang, J.-S., Lee, S., & Soh, K.-S. (2003). Left-right asymmetry of biophoton emission from hemiparesis patients. *Indian Journal of Experimental Biology, 41*(5), 452–456.

Jung, H.-H., Yang, J.-M., Woo, W.-M., Choi, C., Yang, J.-S., & Soh, K.-S. (2005). Year-long biophoton measurements: Normalized frequency count analysis and seasonal dependency. *Journal of Photochemistry and Photobiology B: Biology, 78*(2), 149–154. https://doi.org/10.1016/j.jphotobiol.2004.08.002

Kalaji, H. M., Goltsev, V., Bosa, K., Allakhverdiev, S. I., Strasser, R. J., & Govindjee (2012). Experimental in vivo measurements of light emission in plants: A perspective dedicated to David Walker. *Photosynthesis Research, 114*(2), 69–96.

Kayatz, P., Thumann, G., Luther, T. T., Jordan, J. F., Bartz-Schmidt, K. U., Esser, P. J., & Schraermeyer, U. (2001). Oxidation causes melanin fluorescence. *Investigative Ophthalmology & Visual Science, 42*(1), 241–246.

Kobayashi, M., Iwasa, T., & Tada, M. (2016). Polychromatic spectral pattern analysis of ultra-weak photon emissions from a human body. *Journal of Photochemistry and Photobiology B: Biology, 159*, 186–190. https://doi.org/10.1016/j.jphotobiol.2016.03.037

Kobayashi, M., Kikuchi, D., & Okamura, H. (2009). Imaging of ultraweak spontaneous photon emission from human body displaying diurnal rhythm. *PLoS One, 4*(7), e6256. https://doi.org/10.1371/journal.pone.0006256

Kobayashi, K., Okabe, H., Kawano, S., Hidaka, Y., & Hara, K. (2014). Biophoton emission induced by heat shock. *PLoS One, 9*(8), e105700. https://doi.org/10.1371/journal.pone.0105700

Moraes, T. A., Barlow, P. W., Klingelé E., & Gallep, C. M. (2012). Spontaneous ultraweak light emissions from wheat seedlings are rhythmic and synchronized with the time profile of the local gravimetric tide. *Naturwissenschaften, 99*(6), 465–472. https://doi.org/10.1007/s00114-012-0921-5

Musumeci, F., Scordino, A., & Triglia, A. (1997). Delayed luminescence from simple biological systems. *Rivista di Biologia, 90*(1), 95–110.

Nakamura, H., Kokubo, H., Parkhomtchouk, D. V., Chen, W., Tanaka, M., Zhang, T., Kokado, T., Yamamoto, M., & Fukuda, N. (2000). Biophoton and temperature changes of human hand during Qigong. *Journal of International Society of Life Information Science, 18*(2), 418–422.

Pederzoli, L., Giroldini, W., Prati, E., & Tressoldi, P. (2017). The physics of mind-matter interaction at a distance. *NeuroQuantology, 15*(3), 114–119. https://doi.org/10.2139/ssrn.2968430

Persinger, M. A., & St-Pierre, L. S. (2011). The biophysics at death: Three hypotheses with potential application to paranormal phenomena. *NeuroQuantology, 9*(1), 36–40. https://doi.org/10.14704/nq.2011.9.1.388

Piao, D. (2020a). On the stress-induced photon emission from organism: I, will the scattering-limited delay affect the temporal course? *SN Applied Sciences*, 2, 1566.

https://doi.org/10/1007/s42452-020-03346-1
Piao, D. (2020b). On the stress-induced photon emission from organism: II, how will the stress-transfer kinetics affect the photo-genesis? *SN Applied Sciences, 2*, 1556. https://doi.org/10/1007/s42452-020-03347-0
Piao, D., Barbour, R. L., Graber, H. L., & Lee, D. C. (2015). On the geometry dependence of differential pathlength factor for near-infrared spectroscopy. I. Steady-state with homogeneous medium. *Journal of Biomedical Optics, 20*(10), 105005. https://doi.org/0.1117/1.JBO.20.10.105005
Quickenden, T. I., & Que Hee, S. S. (1974). Weak luminescence from the yeast Saccharomyces cerevisiae and the existence of mitogenetic radiation. *Biochemical and Biophysical Research Communications, 60*(2), 764–770. https://doi.org/10.1016/0006-291X(74)90306-4
Rahnama, M., Tuszynski, J. A., Bókkon, I., Cifra, M., Sardar, P., & Salari, V. (2011). Emission of mitochondrial biophotons and their effect on electrical activity of membrane via microtubules. *Journal of Integrative Neuroscience, 10*(1), 65–88. https://doi.org/10.1142/S0219635211002622
Reddy, J. S. K. (2016). Could 'biophoton emission' be the reason for mechanical malfunctioning at the moment of death? *NeuroQuantology, 14*(4), 806–809.
Rice, M. E., Forman, R. E., Chen, B. T., Avshalumov, M. V., Cragg, S. J., & Drew, K. L. (2002). Brain antioxidant regulation in mammals and anoxia-tolerant reptiles: Balanced for neuroprotection and neuromodulation. *Comparative Biochemistry and Physiology, Part C: Toxicology and Pharmacology, 133*(4), 515–525.
Rubik, B., & Jabs, H. (2017). Effects of intention, energy healing, and mind-body states on biophoton emission. *Cosmos and History: The Journal of Natural and Social Philosophy, 13*(2), 227–247.
Salari, V., Scholkmann, F., Vimal, R. L. P., Császár, N., Aslani, M., & Bókkon, I. (2017). Phosphenes, retinal discrete dark noise, negative afterimages and retino-geniculate projections: A new explanatory framework based on endogenous ocular luminescence. *Progress in Retinal and Eye Research, 60*, 101–119.
Sarna, S., Sahi, T., Koskenvuo, M., & Kaprio, J. (1993). Increased life expectancy of world class male athletes. *Medicine & Science in Sports & Exercise, 25*(2), 237–244.
Sauermann, G., Mei, W. P., Hoppe, U., & Stäb, F. (1999). Ultraweak photon emission of human skin in vivo: Influence of topically applied antioxidants on human skin. *Methods in Enzymology, 300*, 419–428. https://doi.org/10.1016/S0076-6879(99)00147-0
Slawinski, J., Ezzahir, A., Godlewski, M., Kwiecinska, T., Rajfur, Z., Sitko, D., & Wierzuchowska, D. (1992). Stress-induced photon emission from perturbed organisms. *Experientia, 48*(11–12), 1041–1058. https://doi.org/10.1007/BF01947992
Sun, M., Van Wijk, E., Koval, S., Van Wijk, R., He, M., Wang, M., Hankemeier, T., & van der Greef, J. (2017). Measuring ultra-weak photon emission as a non-invasive diagnostic tool for detecting early-stage type 2 diabetes: A step toward personalized medicine. *Journal of Photochemistry and Photobiology B: Biology, 166*, 86–93. https://doi.org/10.1016/j.jphotobiol.2016.11.013
Tsuchida, K., Iwasa, T., & Kobayashi, M. (2019). Imaging of ultraweak photon

emission for evaluating the oxidative stress of human skin. *Journal of Photochemistry and Photobiology B: Biology, 198*, 111562. https://doi.org/10.1016/j.jphotobiol.2019.111562

Van Wijk, R., Van Wijk, E. P. A., van Wietmarschen, H. A., & van der Greef, J. (2014). Towards whole-body ultra-weak photon counting and imaging with a focus on human beings: A review. *Journal of Photochemistry and Photobiology B: Biology, 139*, 39–46. https://doi.org/10.1016/j.jphotobiol.2013.11.014

Wang, J., & Yu, Y. (2009). Relationship between ultra-weak bioluminescence and vigour or irradiation dose of irradiated wheat. *Luminescence, 24*(4), 209–212. https://doi.org/10.1002/bio.1096

Wang, C., Bókkon, I., Dai, J., & Antal, I. (2011). Spontaneous and visible light-induced ultraweak photon emission from rat eyes. *Brain Research, 1369*, 1–9. https://doi.org/10.1016/j.brainres.2010.10.077

Wang, Z., Wang, N., Li, Z., Xiao, F., & Dai, J. (2016). Human high intelligence is involved in spectral redshift of biophotonic activities in the brain. *Proceedings of the National Academy of Sciences USA, 113*(31), 8753–8758. https://doi.org/10.1073/pnas.1604855113

Wilson, H. R., & Cowan, J. D. (1972). Excitatory and inhibitory interactions in localized populations of model neurons. *Biophysics Journal, 12*(1), 1–24. https://doi.org/10.1016/S0006-3495(72)86068-5

Yang, W., Zhou, W., Lv, Y., & Song, W. (1995). Ultraweak photon emission experimental study on the torso meridian of 80 healthy people. *Shenzhen Zhongxiyi Jiehe Zazhi, 5*(3), 1–3.

Yang, W. Y., Zhou, W. X., Song, W., & Lv, Y. (1996). Ultraweak photon emission experimental study on the four limbs meridian of 130 healthy people. *Shanghai ZhenjiuZazhi, 15*(1), 34–35.

Zhang, A., Piao, D., Bunting, C. F., & Pogue, B. W. (2010). Photon diffusion in a homogeneous medium bounded externally or internally by an infinitely long circular cylindrical applicator. I. Steady-state theory. *Journal of the Optical Society of America, A: Optics, Image Science, and Vision, 27*(3), 648–662. https://doi.org/10.1364/JOSAA.27.000648

Zhang, J., Yu, W., Sun, T., & Popp, F.-A. (1997). Spontaneous and light-induced photon emission from intact brains of chick embryos. *Science in China Series C: Life Sciences, 40*(1), 43–51.

Zhao, X., Pang, J., Fu, J., Wang, Y., Yang, M., Liu, Y., Fan, H., Zhang, L., & Han, J. (2017). Spontaneous photon emission: A promising non-invasive diagnostic tool for breast cancer. *Journal of Photochemistry and Photobiology, B, 166*, 232–238. https://doi.org/10.1016/j.jphotobiol.2016.12.009

Zhao, X., van Wijk, E., Yan, Y., van Wijk, R., Yang, H., Zhang, Y., & Wang, J. (2016). Ultra-weak photon emission of hands in aging prediction. *Journal of Photochemistry and Photobiology B: Biology, 162*, 529–534. https://doi.org/10.1016/j.jphotobiol.2016.07.030

Zheng, R., Lu, J., Lin, Y., & Zhang, M. (1983). The studies of the relationship between human body surface ultraweak luminescence and certain physiological state. *Shanghai Zhongyiyao Zazhi, 1*(1), 44–47.

APPENDIX

Steady-State Photon Diffusion in an Unbounded Medium of Spherical Geometry

With the placement of a steady-state photo-genic source in the spherical tissue domain representing the human body, the steady-state propagation of the photon in the spherical domain that is several orders greater than the photon-scattering path-length in a biological tissue can be readily modeled by the diffusion approximation to the radiative transfer equation (Ishimaru, 1989). The human body is treated in the present work as a globally homogeneous diffusive medium containing localized steady-state spatially impulsive photo-genic sources. The diffusive tissue medium is characterized by the following properties: absorption coefficient $\boldsymbol{\mu_a}$ [unit: cm^{-1}], reduced scattering coefficient $\boldsymbol{\mu_s'}$ [unit: cm^{-1}], diffusion coefficient $\boldsymbol{D = 1/[3(\mu_a + \mu_s')]}$ [unit: cm], and effective attenuation coefficient $\boldsymbol{\mu_{eff} = \sqrt{\mu_a/D}}$ [unit: cm^{-1}]. For a field or detection position at $\vec{\chi} = (\boldsymbol{r}, \boldsymbol{\theta}, \boldsymbol{\varphi})$ within the globally homogeneous tissue domain including that on the tissue–air boundary, the steady-state photon-fluence rate $\boldsymbol{\Psi}(\vec{\chi})$ (unit: Ws^{-1}cm^{-2}) satisfies the following governing equation (Contini et al., 1997):

$$\nabla^2\Psi(\vec{\chi}) - \frac{\mu_a}{D}\Psi(\vec{\chi}) = -\frac{S(\vec{\chi})}{D} \tag{A1}$$

where $S(\vec{\chi})$ is a source term, which is also subject to a boundary condition as all boundary-involved electromagnetic problems are. For an infinite homogeneous medium containing a steady-state point source at $\vec{\chi}'$ with an intensity S as represented by $S \cdot \delta(\vec{\chi}')$, Eq. (A1) has the well-known Green's function solution of (Zhang et al., 2010):

$$\Psi(\vec{\chi}, \vec{\chi}') = \frac{S}{4\pi D}\frac{1}{|\vec{\chi} - \vec{\chi}'|}exp\left(-\mu_{eff}|\vec{\chi} - \vec{\chi}'|\right) \tag{A2}$$

Eq. (A2) can also be written in the following form of Eigen function expansion (Piao et al., 2015):

$$\Psi(\vec{\chi}, \vec{\chi}') = \frac{S}{D}(\mu_{eff})\sum_{l=0}^{\infty}\left[i_l(\mu_{eff}r_<)\cdot k_l(\mu_{eff}r_>)\right]\sum_{m=-l}^{l}\left[Y_{lm}^*(\theta', \phi')\cdot Y_{lm}(\theta, \phi)\right] \tag{A3}$$

where i_l and k_l are respectively the l-th order modified spherical Bessel function of the first and the second kinds, $r_<$ and $r_>$ are, respectively, the smaller and greater radial coordinates between the source and the detector, and Y_{lm} is the spherical harmonics function.

Treatment of the Boundary Condition Associated with Steady-State Biophoton Emission from a Spherical Surface

With regard to the effect on photon-fluence rate by the tissue–air boundary, it has been established that the photon-fluence rate does not become zero at a field position immediately beyond the tissue boundary; instead, a more accurate treatment of an extrapolated zero-boundary condition sets zero for the photon-fluence rate at a distance away from the tissue boundary—the so-called extrapolated zero-boundary (Haskell et al., 1994). Figure 3 with the implementation of the extrapolated zero-boundary is illustrated in Figure A1. A field $\vec{\chi}$ point on or beyond the spherical tissue boundary locates at (r, θ, φ) with $r_> = R_0 + R_b$. The application of the extrapolated zero-

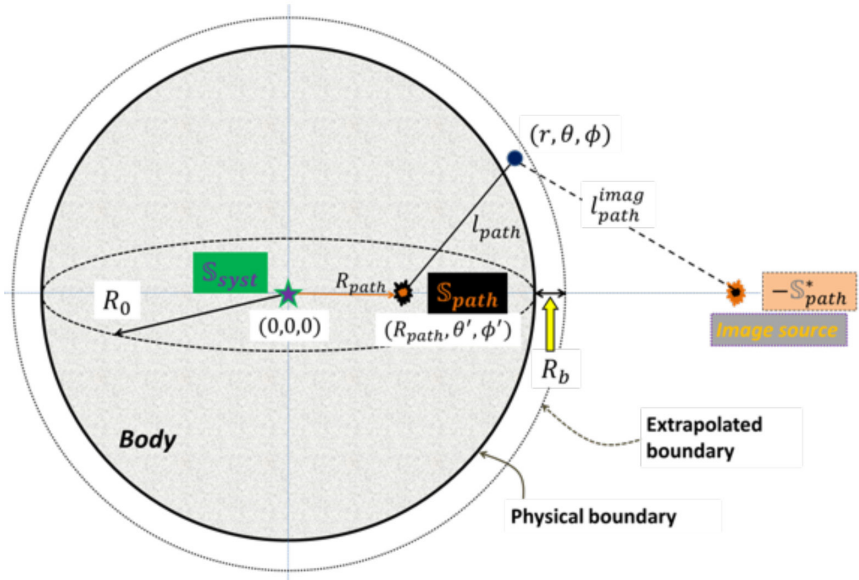


Figure A1. The human body containing a physiological photo-genic source of $\mathbb{S}_{syst}$ at the center of the spherical domain, and a single pathological photo-genetic $\mathbb{S}_{path}$ source at $(\mathbf{R}_{path}, \mathbf{0}, \mathbf{0})$. The photon emitted by a photo-genic source diffuses in the human body and encounters a refractive index discontinuity at the body boundary. The effect of the tissue–air boundary is accounted for by setting the photon-fluence rate at an imaginary boundary extrapolated from the physical boundary at a distance of R_b. The image of the single pathological photo-genetic source $\mathbb{S}_{path}$ is located at the radial direction $\mathbb{S}_{path}$ of due to the obvious symmetry. The intensity of the image of the single pathological photo-genetic source $\mathbb{S}_{path}$ may become $-\mathbb{S}_{path}$ in the case of the tissue becoming a semi-infinite domain.

boundary condition to the photon fluence associated with any source within the tissue medium is satisfied by introducing an "image" of the source with respect to the extrapolated zero-boundary that is co-centric with and at a radial distance of $R_b = 2AD$ outward from the physical boundary (Piao et al., 2015) where

$$A = (1+\xi)/(1-\xi), \xi = -1.440n^{-2} + 0.710n^{-1} + 0.668 + 0.0636n,$$

and n is the refractive index of the air-bounding tissue. As the composite photon-fluence rate resulting from both the physical source in the tissue medium and the image of it becomes zero at the extrapolated zero-boundary, the composite positive photon-fluence rate elsewhere resulting from the same two sources of one being physical and the other being imaginary thus become the solution in the associated physical space within the body volume or beyond the boundary, according to the unique characteristics of all the electromagnetic properties.

For the pathological photo-genic source $\mathbb{S}_{path}$ located off-center at $(R_{path}, \theta', \phi')$, the geometric symmetry determines that the image of it with respect to the extrapolated zero-boundary must be located along the same radial direction. The source $\mathbb{S}_{path}$ and its image with respect to the extrapolated zero-boundary thus collectively set at zero the photon-fluence rate on the extrapolated zero-boundary. Based on Eq. (A3), the photon-fluence rate associated with the pathological photo-genic source $\mathbb{S}_{path}$ and evaluating on the extrapolated zero-boundary, for which the source locates at $r_< = R_{path}$ and the field point locates at $r_> = R_0 + R_b$, is

$$\Psi_{path}\big|_{extra} = \mathbb{S}_{path}\frac{1}{D}(\mu_{eff})\sum_{l=0}^{\infty} i_l[\mu_{eff}\cdot(R_{path})]\cdot k_l[\mu_{eff}(R_0+R_b)] \sum_{m=-l}^{l} Y_{lm}^*(\theta',\phi')Y_{lm}(\theta,\phi) \quad \text{(A4)}$$

where the notation "$_{left}\big|_{right}$" indicates evaluating the "left" term as the source and the "right" term as the field position. Note that any "l"th order (or moment) of the pathological photo-genic source has the same intensity as $\mathbb{S}_{path}$.Similarly, the photon-fluence rate associated with the image of the pathological photo-genic source, and evaluated on the extrapolated zero-boundary, for which the source now is located at a radial position of a to-be-determined $r_>$ and the detector located at $r_< = R_0 + R_b$, is

$$\Psi_{path}^{imag}\big|_{extra} = \frac{1}{D}(\mu_{eff})\sum_{l=0}^{\infty} S_l^*\cdot i_l[\mu_{eff}(R_0+R_b)]\cdot k_l[\mu_{eff}r_>] \sum_{m=-l}^{l} Y_{lm}^*(\theta',\phi')Y_{lm}(\theta,\phi) \quad \text{(A5)}$$

where the term S_l^* is different for different "l" (or moment). Based on the essence of "image-source" (Zhang et al., 2010; Piao et al., 2015), the two unknown terms S_l^* and $r_>$ associated with the l-th order (or moment) "image" source (the component) can be expressed by a single unknown term S_l associated with the same order (or moment) of the actual pathological photo-genic source $\mathbb{S}_{path}$ located within the tissue at $(R_{path}, \theta', \phi')$, (the i_l component), as the following:

$$S_l^* \cdot k_l\left[\mu_{eff} r_>\right] = S_l \cdot i_l\left[\mu_{eff}\left(R_{path}\right)\right] \tag{A6}$$

Applying the extrapolated zero-boundary condition of

$$\Psi_{path}\big|_{extra} + \Psi_{path}^{imag}\big|_{extra} = 0$$

leads to

$$S_l = -\mathbb{S}_{path} \frac{k_l\left[\mu_{eff}(R_0+R_b)\right]}{i_l\left[\mu_{eff}(R_0+R_b)\right]} \quad l = 0,1,2,\ldots \tag{A7}$$

Now for the photon-fluence rate associated with the pathological photo-genic source at $(R_{path}, \theta', \phi')$, but evaluating at a field point between the body boundary and the extrapolated zero-boundary, the source still locates at $r_< = R_{path}$ but the detector or the field point locates at $r_> = R_0 + \Delta r$, where $\Delta r \in [0, R_b]$. For the photon-fluence rate associated with the image of the pathological photo-genic source and also evaluating at a field point between the body boundary and the extrapolated zero-boundary, the field point now is located at $r_< = R_0 + \Delta r$ and the source terms are known through Eqs. (A6) and (A7). Collectively the composite photon-fluence rate originating from a pathological photo-genic source at $(R_{path}, \theta', \phi')$, and sensed by a detector or field point at $(R_0 + \Delta r, \theta, \phi)$ between the body boundary and the extrapolated zero-boundary becomes:

$$\begin{aligned}
\Psi_{path} &= \Psi_{path}\big|_{field} + \Psi_{path}^{imag}\big|_{field} \\
&= \frac{\mathbb{S}_{path}}{D}\left(\mu_{eff}\right)\sum_{l=0}^{\infty} i_l\left[\mu_{eff}\left(R_{path}\right)\right] \cdot k_l\left[\mu_{eff}\left(R_0+\Delta r\right)\right] \sum_{m=-l}^{l} Y_{lm}^*(\theta', \phi') Y_{lm}(\theta, \phi) \\
&- \frac{\mathbb{S}_{path}}{D}\left(\mu_{eff}\right)\sum_{l=0}^{\infty} \cdot i_l\left[\mu_{eff}(R_0+\Delta r)\right] i_l\left[\mu_{eff}\left(R_{path}\right)\right] \cdot \frac{k_l\left[\mu_{eff}(R_0+R_b)\right]}{i_l\left[\mu_{eff}(R_0+R_b)\right]} \sum_{m=-l}^{l} Y_{lm}^*(\theta', \phi') Y_{lm}(\theta, \phi) \\
&= \frac{\mathbb{S}_{path}}{D}\left(\mu_{eff}\right)\sum_{l=0}^{\infty} i_l\left[\mu_{eff}\left(R_{path}\right)\right] \cdot k_l\left[\mu_{eff}\left(R_0+\Delta r\right)\right] \sum_{m=-l}^{l} Y_{lm}^*(\theta', \phi') Y_{lm}(\theta, \phi) \\
&\quad \left\{1 - \frac{i_l\left[\mu_{eff}(R_0+\Delta r)\right]}{k_l\left[\mu_{eff}(R_0+\Delta r)\right]} \frac{k_l\left[\mu_{eff}(R_0+R_b)\right]}{i_l\left[\mu_{eff}(R_0+R_b)\right]}\right\}
\end{aligned} \tag{A8}$$

Equation (A8) contains two parts: the "1" in the bracket represents the infinite-medium contribution to the photon-fluence rate by the pathological photo-genic source $\mathbb{S}_{path}$ that can be expressed in the simple form of Eq. (A2); and the other term in the bracket scales the infinite-medium contribution to the photon-fluence rate by the image of the pathological photo-genic $\mathbb{S}_{path}$ source with respect to the former one. By using some analytics of the modified spherical Bessel function and Eq. (A2), Eq. (A8) is converted to the following form (Piao et al., 2015)

$$\Psi_{path} = \frac{\mathbb{S}_{path}}{4\pi D}\frac{1}{l_{path}} exp\left(-\mu_{eff} l_{path}\right)\left\{1 - \frac{I_{l+1/2}[\mu_{eff}(R_0+\Delta r)]}{K_{l+1/2}[\mu_{eff}(R_0+\Delta r)]}\frac{K_{l+1/2}[\mu_{eff}(R_0+R_b)]}{I_{l+1/2}[\mu_{eff}(R_0+R_b)]}\right\} \tag{A9}$$

where $I_{l+\frac{1}{2}}$ and $K_{l+\frac{1}{2}}$ are respectively the $\left(l+\frac{1}{2}\right)$-th order modified Bessel function of the first and the second kinds. For a human body simplified as a spherical domain, it is easy to have an R_0 (i.e., 10 cm) that is substantially greater than 10 times $1/\mu_{eff}$ and to have the second term in the bracket of Eq. (A9) approximated by

$$\frac{I_{l+1/2}[\mu_{eff}(R_0+\Delta r)]}{K_{l+1/2}[\mu_{eff}(R_0+\Delta r)]}\frac{K_{l+1/2}[\mu_{eff}(R_0+R_b)]}{I_{l+1/2}[\mu_{eff}(R_0+R_b)]} = exp\left[-2\mu_{eff}(R_b-\Delta r)\right] \tag{A10}$$

Thus, Eq. (A9) will be changed to a trivial form of

$$\Psi_{path} = \frac{\mathbb{S}_{path}}{4\pi D}\frac{1}{l_{path}} exp\left(-\mu_{eff} l_{path}\right)\left\{1 - exp\left[-2\mu_{eff}(R_b-\Delta r)\right]\right\} \tag{A11}$$

Eq. (A11), which is associated with the pathological photo-genic source of $\mathbb{S}_{path}$, conveniently satisfies the condition of producing a zero composite photon-fluence rate at the extrapolated zero-boundary, whereupon $\Delta r = R_b$. Eq. (A11) also determines that the photon-fluence rate associated with the pathological photo-genic source of $\mathbb{S}_{path}$ which decreases monotoni-cally from the body boundary to the extrapolated zero-boundary. One can find that a hypothetical movement of the photo-genic source $\mathbb{S}_{path}$ like the pathological one from $(R_{path}, \theta', \phi')$ toward the center of the spherical domain can maintain the boundary-resulted composite photon-fluence rate in the form of Eq. (A11), with the length dimension l_{path} varying according to the position of the photo-genic source. The hypothetical experiment infers that

the boundary-resulted composite photon-fluence rate at a field point at $(R_0 + \Delta r, \theta, \varphi)$ in association with a physiological photo-genic source $\mathbb{S}_{syst}$ located at the center of the spherical domain can be represented as the following:

$$\Psi_{syst} = \frac{\mathbb{S}_{syst}}{4\pi D} \frac{1}{l_{syst}} exp\left(-\mu_{eff} l_{syst}\right)\left\{1 - exp\left[-2\mu_{eff}(R_b - \Delta r)\right]\right\} \quad \text{(A12)}$$

where l_{syst} is the distance from the physiological photo-genic source to the field point. When both the physiological photo-genic source $\mathbb{S}_{syst}$ and the pathological photo-genic source $\mathbb{S}_{path}$ are considered as the origins of the photon emission causing photon distribution beyond the spherical boundary, the composite photon-fluence rate at a field point $(R_0 + \Delta r, \theta, \phi)$ is thus the combination of the respective photon-fluence rates of Eqs. (A1) and (A12), as the following:

$$\Psi_{total} = \frac{1}{4\pi D}\left[\mathbb{S}_{syst} \frac{1}{l_{syst}} exp\left(-\mu_{eff} l_{syst}\right) + \mathbb{S}_{path} \frac{1}{l_{path}} exp\left(-\mu_{eff} l_{path}\right)\right] \left\{1 - exp\left[-2\mu_{eff}(R_b - \Delta r)\right]\right\} \quad \text{(A13)}$$

Regarding Slow Photon Sourcing for Steady-State Biophoton Emission

Ideally, the temporal profile of the photons measured at the tissue surface shall be the convolution of the source temporal profile with the temporal point-spread function of the photon diffusion process. All changes of biophotons measured at the surface over the scales assessed in this work can be safely treated as infinitely large compared with the time that a biophoton takes to propagate from a site of photo-genesis to the surface. This essentially makes the surface measurement of biophotons follow exactly the temporal pace of the photo-genesis term, which shall reflect what has happened due to physiological, environmental, or pathological conditions.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 383–388, 2021 0892-3310/21

COMMENTARY

Reply to: Grote, H. (2018). Commentary: Intentional observer effects on quantum randomness: A Bayesian analysis reveals evidence against micro-psychokinesis. *Frontiers in Psychology, 9*, 1350. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01350/full

Markus A. Maier

markus.maier@psy.lmu.de
Department of Psychology, Ludwig-Maximilians-Universität München, Germany

Moritz C. Dechamps

Department of Psychology, Ludwig-Maximilians-Universität München, Germany

Günter Schiepek

Department of Psychology, Ludwig-Maximilians-Universität München, Germany

Submitted April 10, 2019; Accepted February 22, 2021; Published June 15, 2021

https://10.31275/20211535

Keywords: quantum observation; micro-psychokinesis (micro-PK); model of pragmatic information, random number generation; RNG

Maier et al. (2018) reported a study that tested mind–matter effects in a micro-psychokinesis (micro-PK) task. They found strong evidence against micro-Pk in a Bayesian analysis of the aggregate sample's mean score when tested against its expectation value. In addition, they performed supplementary post hoc analyses testing the sequential time course of the effect among participants; these additional tests aimed to explore a postulated systematic time-dependent variation of

this effect. Unsystematic variations of micro-PK effects, and thus an overall decline of effect sizes across studies, have been theoretically postulated by von Lucadou et al. (2007) and meta-analyses seemed to confirm their proposition (see Walach et al., 2014, p. 624). Maier et al. (2018) slightly extended this innovative approach by arguing that the time course of experimental evidence for micro-PK effects will vary in a systematic and oscillative manner, rather than varying unsystematically. Their argument maintains that any violations of the core principles of standard quantum mechanics, such as the randomness postulate, would also violate the Second Law of Thermodynamics. Consequently, the authors suspected a time-delayed entropic counter-mechanism that, through interaction with the micro-PK effect, might lead to an oscillative change in the evidence for that effect over time. Accordingly, this should lead to non-random periodic changes of the effect. Maier et al. (2018) estimated a harmonic oscillative function of the experimental data, represented as a cumulative *z*-score that varied with increased sample size, and compared the oscillation amplitude parameter ω and its confidence interval with that of one set of simulated data.

Grote (2018) criticizes this procedure on two levels: First, he argues that due to its cumulative nature the cumulative *z*-score, which possesses strong similarities with the sequential Bayes Factor of the main analysis, must always have a tendency to decline given a constant oscillation of an original effect size; this is because more data go into the *z*-score calculation. The authors of this paper agree with Grote's argument that artificial oscillations are, to an extent, produced by accumulation of the effect among participants. However, these authors argue that these method-specific variations of evidence for the effect can be controlled by comparing the experimental data with an enormous number of simulated data that have been treated with the same accumulation algorithm. In the analyses provided below, we provide 10,000 simulated datasets that match the human data in every methodological detail. These data were obtained using the same true random number generator (tRNG) with which Maier et al.'s (2018) participants interacted. If more pronounced systematic variations with significantly higher amplitudes were to be found in the original experimental data as compared with these control datasets, then any artificial contributions could be ruled out since they were kept constant.

Grote's (2018) second argument was based on an empirical finding. Specifically, when Grote compared the ω -score of the experimental data reported by Maier et al. (2018) with 1,000 control data created by random permutations of the original data, more than 38% of the simulated ω -parameters were higher than the ones in the original data. These authors agree with Grote's conclusion that this indicates an insignificant difference from these random datasets.

These authors, however, do not agree with Grote's conclusion that these higher dominant frequencies found within many of the simulated ωs contradict Maier et al.'s theory of non-random, high-amplitude oscillations in the experimental data. Conversely, these authors argue that the method used by Maier et al. (2018), when estimating the frequency parameter and its amplitude, was insufficient. In an additional post hoc analysis, these authors therefore applied a state-of-the-art methodology to the original sequential Bayesian analysis to identify non-random, periodic variations therein. The Bayes Factor is strongly indicative of evidence for a micro-PK effect (as well as its counter-mechanism) and was originally used by Maier et al. (2018) to test the existence of micro-PK. The new non-randomness check was applied to this sequential Bayes factor representing the micro-PK effect. The analysis performed has previously been used in many scientific fields to determine periodicity of time series data. This mathematical approach, which uses an algorithm called the Fast Fourier Transform (FFT), can be used for a time series. FFT explores periodic dynamics or rhythms in time series data, disaggregating any dynamic pattern therein into its sinusoidal frequency components (Penrose, 2017, p. 461). The amplitudes of these components obtained from the sequential Bayes Factor were then compared with those received from the FFTs of 10,000 simulated datasets that were obtained from the same tRNG used in the Maier et al. (2018) research and their sequential Bayes Factors (each with an $n = 12{,}571$).

An FFT was conducted on the sequential Bayesian analysis of the original experimental data, as well as on each of the 10,000 simulated datasets, using a sampling rate of 1/12,571. Since the resulting transform is symmetrical, only the first half is considered in the analysis. Subsequently, we compared the amplitudes of these 6,285 frequencies

(12,571/2) of the original human data, with those of the simulated control data. To perform a test of significance, all amplitudes obtained from the FFT of the human dataset were added up, creating a sum score (Sum_{amp}). In the same way for each of the 10,000 simulations, the sum score of amplitudes was computed. The distribution of the sum scores of amplitudes across all simulations then served as the null distribution (see Figure 1). The sum score of amplitudes of the human

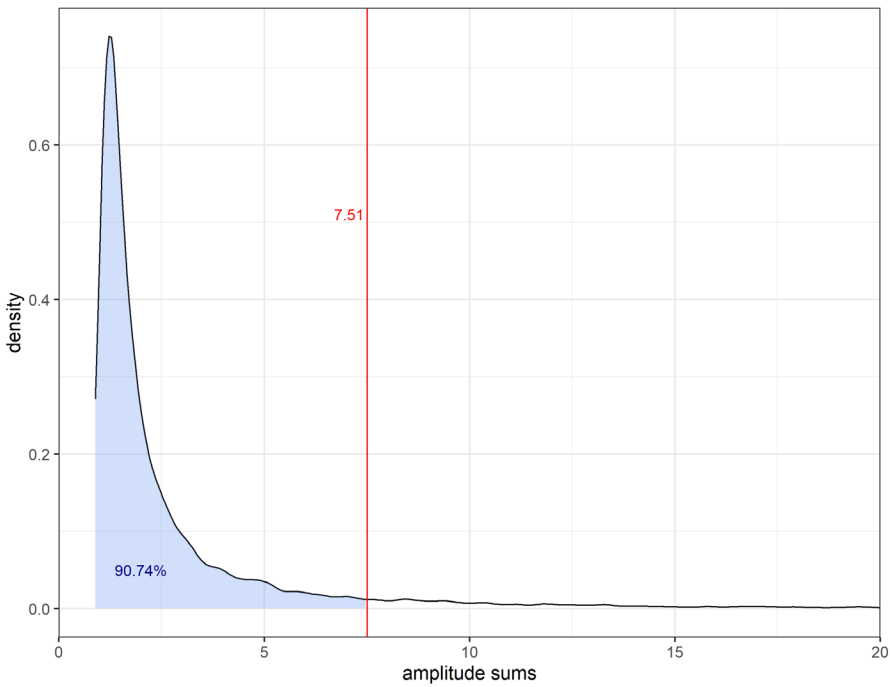


Figure 1. **Density distribution for the Sum_{amp}-scores obtained from FFT analyses performed with 10,000 simulations (black line = null distribution). The red line (straight vertical line) indicates the Sum_{amp} obtained from the FFT performed on the sequential Bayes Factor of the human data. The blue (shaded) area indicates the number of simulations that produced smaller Sum_{amp}s in their FFTs (90.74%).**

dataset was $Sum_{amp} = 7.51$. Only 926 of the 10,000 simulations' Sum_{amp}-scores (9.26%) reached a Sum_{amp}-score of 7.51 or higher.

In sum, the experimental data provided by Maier et al. (2018) contain a marginally significant amount of non-random periodic changes across time. This finding does not fully support Maier et al.'s (2018) post hoc claim that non-random, periodic changes with amplitudes higher than those expected from chance occur in their data. However, the statistical trend provides some hints that exploring oscillation patterns might be a fruitful strategy to test micro-PK effects in future studies.

A systematic variation of micro-PK effects, rather than their unsystematic disappearance over time, seems to be the viable hypothesis. In future research, micro-PK effects and similar psi-related phenomena should be analyzed according to non-random periodic changes using FFT analyses, rather than testing an overall mean score of the sample against chance (see, e.g., Dechamps & Maier, 2019).

REFERENCES

Dechamps, M. C., & Maier, M. A. (2019). How smokers change their world and how the world responds: Testing the oscillatory nature of micro-psychokinetic observer effects on addiction-related stimuli. *Journal of Scientific Exploration, 33*(3), 406–434.

Grote, H. (2018). Commentary: Intentional observer effects on quantum randomness: A Bayesian analysis reveals evidence against micro-psychokinesis. *Frontiers in Psychology*, *9*, 1350. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01350/full

Maier, M. A., Dechamps, M. C., & Pflitsch, M. (2018). Intentional observer effects on quantum randomness: A Bayesian analysis reveals evidence against micro-psychokinesis. *Frontiers in Psychology*, *9*, 379. https://doi.org/10.3389/fpsyg.2018.00379

Penrose, R. (2017). *Fashion, faith, and fantasy in the new physics of the universe*. Princeton University Press.

von Lucadou, W., Römer, H., & Walach, H. (2007). Synchronistic phenomena as

entanglement correlations in Generalized Quantum Theory. *Journal of Consciousness Studies*, *14*(4), 50–74.

Walach, H., von Ludacou, W., & Römer, H. (2014). Parapsychological phenomena as examples of generalized nonlocal correlations—A theoretical framework. *Journal of Scientific Exploration*, *28*(4), 605–631.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 389–404, 2021 0892-3310/21

ESSAY REVIEW

Historical Views of Spiritism and Mediumship in Spain, 1880–1930

Ciencia y Espiritismo en España, 1880–1930 [Science and Spiritism in Spain, 1880–1930] by Andrea Graus. Comares, 2019. viii + 134 pp. €14 (paperback). ISBN 978-84-9045-898-3.

Reviewed by Carlos S. Alvarado

carlos@theazire.org

https://10.31275/20211843

INTRODUCTION

Little is known by non-Spanish speakers about the history of Spiritism and psychical research in Spain. Standard English-language sources such as Frank Podmore's *Modern Spiritualism* (1902) and Arthur Conan Doyle's *The History of Spiritualism* (1926) do not cover developments in that country.[1] There is a useful historical outline of the topic in philosopher and educator Mario Méndez Bejarano's *Historia de la Filosofía en España Hasta el Siglo XX* (n.d., Chapter 17, Part 14). Much of relevance can be found in the new historiography about the subject in Spain which, like that in some other countries, has grown in recent decades.[2] Other recent studies have included psychical research as well. Particularly useful are the essays compiled by Annette Mülberger (2016) in *Los Límites de la Ciencia: Espiritismo, Hipnotismo y el Estudio de los Fenómenos Paranormales (1850–1930)*, and articles about such topics as the attitudes and approaches of specific investigators (Vilaplana Traviera & Mülberger, 2003), turning tables (González de Pablo, 2006), and prominent clairvoyance studies (Mülberger & Balltondre, 2013). Andrea Graus, the author of the book reviewed here, has also made various significant contributions.

Graus, a historian at the Centre Alexandre Koyré, has published

various articles about mediumistic investigations, and the ideas of Spanish physicians (e.g., Graus, 2015, 2016). This work has been expanded in the book reviewed here, *Ciencia y Espiritismo en España, 1880–1930* (see Figure 1).

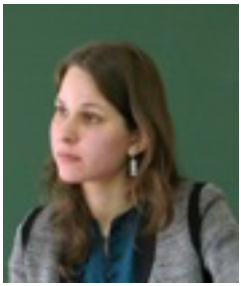


Figure 1. Andrea Graus and her book.

Spiritism developed in the second half of the nineteenth century in Spain, following the line of Allan Kardec, who was particularly influential in France (Sharp, 2006). From the 1850s on, several Spanish mediums and students of the subject appeared. The Catholic Church must have felt the movement was growing too much, when on October 9, 1861, they burnt more than 300 spiritist books in Barcelona that came into the country illegally for a French librarian who resided in the city.[3]

By 1888, when the first of various later international spiritist congresses was held in Barcelona, spiritists included important leaders such as writer Amalia Domingo y Soler (Figure 2), notary José María Fernández Colavida, philosopher Manuel Sanz Benito, and politician and journalist Viscount Antonio de Torres Solanot y Casas, all of whom took part in the congress (Primer Congreso, 1888).

Figure 2. Amalia Domingo y Soler and the cover of the proceedings of the first international Spiritism congress in Barcelona, 1888.

As stated by one of these leaders, the movement came to answer the questions raised in an age of criticism and skepticism, questions that neither science, nor philosophy, nor religion could answer. Spiritism was a "new element of progress" that arrived at "the twilight of a passing age, and it is the dawn of a coming age" which "*puts us in connection with the invisible world, showing us the future life*" (Torres Solanot, 1875, p. 69, italics in the original; this, and other translations, are mine). This author stated he did not want to

impose a belief but instead to invite people to study and experiment. His writings, however, do not show a scientific approach, but rather a missionary perspective that was common among other nineteenth-century writers, both in Spain (Navarro Murillo, 1873–1874) and in other countries (e.g., Brittan, 1851).[4] The individuals covered in the book reviewed here attempted to redefine Spiritism in Spain along more scientific lines.

GRAUS' BOOK

The author states that "by the end of the XIX century there was a slow appropriation of mediumship from the scientific area, especially within psychiatric and psychological domains" (p. 7). A new conception of mediumship emerged that saw the phenomena as the result of the powers of the living medium, as opposed to discarnate agency. The phenomena "were caused by man, be they through unknown faculties or by natural forces that mediums were able to channel" (p. 7). The book is to some extent about representatives of these ideas in Spain.

Later in the book Graus briefly reviews the psychological, and particularly clinical, approach to mediumship, arguing that the "development of theories about automatism, multiple personalities, or altered states of consciousness was strongly influenced by the study of spiritist mediums, who were transformed into subjects of psychological investigation" (pp. 35–36). This idea has generated a specialized literature that has appeared in forums other than those devoted to history (e.g., Alvarado et. al., 2007).

The discussion includes mention of several pioneering non-Spanish writings about the pathology of mediums, such as the ideas about dissociation of French psychopathologist Pierre Janet (p. 41). Janet stated in his classic work *L'Automatisme Psychologique* (1889) that the majority of mediums "are neuropaths, when they are not frankly hysterics" (p. 404). Interestingly, and illustrating Graus' general outlook, an examination of Janet's book shows that he was influenced by psychical researchers. Janet cited the work of well-known English classical scholar and psychical researcher Frederic W. H. Myers to provide examples of dissociation and the phenomena of mediumship (Janet, 1889, pp. 78, 121–122, 135–136, 371, 392–394, 403, 405, 415–419).

He used this material, and writings from spiritists, to provide examples of mediumistic communications in order to construct his model of dissociation, an example of influence from a marginal discipline to a more established one. But the use of Myers' ideas was selective, that is, Janet stripped them from their supernormal component and kept those aspects of it that did not conflict with his views. Incidentally, although Janet did not agree with Myers in several ways, he recognized that Myers had presented a model of dissociation that was more developed than what had been published before (Janet, 1889, p. 403).

Graus starts the first chapter with physician Manuel Otero Acevedo (1865–1920; see Figure 3), who was born in Argentina but was educated and worked mainly in Spain. Initially a self-confessed materialist and a skeptic, this physician eventually accepted the reality of psychic phenomena via his own observations and study of the work of others. For example, he conducted observations about mental suggestion and had séances with Eusapia Palladino that convinced him that her phenomena were real. The latter were mentioned in the second volume of his book *Los Espíritus* (Otero Acevedo, 1893–1895). Otero had séances with the medium in Naples in 1888 and 1889. In a section of the book (Vol. 2, pp. 217–255) he classified the phenomena he observed as complete and partial levitations with the medium touching the table; complete and partial levitations of a table when the medium was not touching the table; action on distant objects; changes of weight in tables; levitation of the medium; direct writing; luminous phenomena (small lights and materialized forms); and impressions of fingers, hands, and faces on plaster. Anyone familiar with the literature about this medium will realize that similar effects were reported by many others in later years (e.g., Carrington, 1909).

Figure 3. Manuel Otero Acevedo and his book *Los Espíritus*.

Otero several times saw violent movements of the séance table. On one occasion he made the medium kneel on a chair and put

both hands inside two cups full of water, hoping to control for hand movements, but the table still moved around. He wrote:

> [The table] responds to questions I ask with movements and blows, and in turn asks if I am satisfied with the event . . . A notable peculiarity: The cups remain firm despite the swings of the table, as if they were attached to the wood . . ." (Otero Acevedo, 1893–1895, Vol. 2, p. 221)

The reports of materialized forms were even more impressive. In one of them, Otero reported that the medium started saying her spine was hurting, and she got nervous, yelled and writhed, and the curtains of the mediumistic cabinet moved. He wrote:

> The curtain is shaken again and at the door appeared the outline of an arm that lengthened and quickly withdrew; waves its hand as if saying hello, and disappears. Immediately it leans out by the edge of the curtain, and at a height that corresponds to the screen in the room [a lamp screen], the silhouette of a head, visible up to the neck . . . The arm comes out again, the head makes some movements and a shadow crosses the door. The head reappears on the opposite side to the one that it previously occupied, and taking a bow disappeared. (Otero Acevedo, 1893–1895, Vol. 2, pp. 246–247)

Interestingly, Graus makes a comparison between Otero and Lombroso, who shared some correspondence. They both started their study of mediums through Palladino and with an ingrained materialist conviction. This led them to deny, a priori, the spiritist hypothesis. Lombroso was influenced by German materialism and tried to give a physiological explanation for mediumistic phenomena. Both of them attempted to place the phenomena observed with Palladino within "official science," but when they could not find a satisfactory explanation that could account for all the facts, they reached the conclusion that there existed phenomena that seemed to explain the existence of spirit (p. 32).

Also interesting, but beyond the scope of this study, is a topic I have discussed before. I am referring to the influence of individuals such as mediums who generate phenomena, in this case the impact that Palladino had on the development of psychical research (Alvarado,

1993). This included converting many individuals to the belief in real physical phenomena, and, in the case of some, of spiritualistic interpretations. Furthermore, this medium exerted much influence on theoretical ideas of psychic forces via her phenomena and behaviors (in interaction with the ideas and agendas of researchers), and in generating for many people negative images of séance phenomena.

The second chapter is about the physician Víctor Melcior i Farré (1860–1929), from the province of Lleida, in Catalonia (see Figure 4). He represented what Graus refers to as an interest that instead of emphasizing spirit action, concentrated on "the interior aspects of the medium, in her subconscious, to try to find the natural cause, psychophysiological, of the spiritist marvels unexplained by science" (p. 36). However, Melcior's approach, as Graus says, differed from the point of view of psychopathologists like Pierre Janet. While Janet only believed in pathology, and not in veridical mental and physical manifestations, Melcior believed in the coexistence of pathology and real phenomena in mediums. This is a conceptual tradition upheld by a few theoreticians, as I have argued in the case of Jules Bernard Luys' ideas of "magnetic" pathology and Cesare Lombroso's explanations of Palladino's physical phenomena (Alvarado, 2019; Alvarado & Biondi, 2017). Interestingly, Graus states that Melcior defended reincarnation following Kardec's ideas (p. 37).

Figure 4. Víctor Melcior i Farré.

The author writes that Melcior believed that mediumistic communications, and the personality changes in mediums, were explained by dissociation, and the physical phenomena by the projection of vital force from the body of the medium. Neither process involved spirits of the dead. Graus writes:

> According to Melcior, the irradiation of such force did not always manifest with the same intensity, which allowed [him] to classify the subjects into three "psychic types": the weak, the medium, and the strong. . . . Melcior defended this stance saying the instability of character and weakness of will facilitated this process . . . [and he argued that] the passing of psychological doubling to the physical depended on the degree of irradiation of the psychic force. In lower levels it induced creaks, movement of objects, levitation, or appari-

> tions of lights. And last: "in the superior degree of doubling there comes out the phantasmal body of a living person, moving to more or less remote places, and coming to be recognized by the person or persons to whom it appears." (pp. 51–52)

Graus is right to relate these ideas to those of Albert de Rochas, who argued that the exteriorization of forces from the body was associated with a fluidic body or double. This had four phases of the exteriorization of a double, the last one being a physical materialization of a human body. This, according to de Rochas, consisted of "a galvanoplastic transport of the matter of the physical body of the medium, matter that comes from the physical body to occupy a similar position on the fluidic body" (de Rochas, 1897, p. 27).

We are introduced to astronomer Josep Comas i Solà (1868–1937; see Figure 5) in the third chapter, and to his séances with medium Carmen Domínguez, who produced, among other phenomena, materializations. While the astronomer may have wanted to bring mediumistic phenomena into science, Graus argues that the spiritists had their own agenda. In her words: "The spiritists did not get in contact with him so that we would confirm the reality of the phenomena, but that, through his authority, he would legitimize them within the scientific sphere" (p. 85). Unfortunately, the whole enterprise did not go well, for Comas accused the medium of fraud, and he entered into controversies about her and the proper way to study mediums, a topic he discussed in his book *El Espiritismo ante la Ciencia* (n.d.).

Figure 5. Josep Comas i Solà.

In this book, Comas argued that the scientific study of natural phenomena would always be legitimate. But a science "based on the study of phenomena that flow from the consciousness of man is condemned, due to its origin, to the infamy of lies" (Comas i Solà, n.d., p. 21), by which he referred to fraud. Interestingly, he went on to discuss physical ideas of matter and energy, from which he speculated on the mechanisms of mediumistic materialization, a phenomenon he did not seem to believe in. In his book, Comas started out assuming that the body of the medium showed a "lack of cohesion or a lack of unity

in its organism" (p. 87) that involved the projection of an "individual" from the medium's body. This "new imponderable and invisible individual, completely or partially away from the *medium*, would have the same forces and the same mentality of the medium, but necessarily diminished" (p. 88) and be similar in shape to the medium's body.

In the fourth chapter we are introduced to physician Humbert Torres i Barberà (1879–1955; see Figure 6), who was in contact with French psychical researchers and studied the medium Marcelle Morell. Graus points out that Torres was educated in French metapsychics, and she provides a brief overview of such developments (pp. 92–101).

Figure 6. Humbert Torres i Barberà.

Torres presented a series of public lectures in 1926 that show he was well-acquainted with the international psychical research literature (De Todas Partes, 1926). The first part, consisting of three presentations, was about phenomena produced by the living, among them telepathy, exteriorization of sensitivity, telekinesis, and materializations. The second part was about phenomena suggestive of discarnate agency. This had two lectures about various mediumistic phenomena and recollection of previous lives.[5] The first included mechanical (table movements and raps), graphic (photographs, automatic writing), spoken (possession, direct writing), plastic (apparitions, materializations) and various other kinds of phenomena (book tests, hauntings).

Graus comments than one of the strategies the French used to separate themselves from Spiritism was a change of terminology, which presented "a view of mediumship that can be defined as 'properly' metapsychic, in that it is destined to show the limits of this field and to be demarcated from Spiritism" (p. 97). This view, I believe, is consistent with Charles Richet's definition of metapsychics without reference to spirits or nonphysical processes. He proposed calling metapsychics "a science which has as its object mechanical or psychological phenomena due to forces which seem intelligent, or to unknown powers latent in human intelligence" (Richet, 1922, p. 5, italics in original removed). However, Torres was open to discarnate agency as an explanation.

In this chapter Graus presents two organizations that represented attempts to organize metapsychics in Spain. These were the Instituto de Metapsiquismo de Barcelona (founded in 1923) and the Sociedad

Española de Estudios Metapsíquicos de Madrid (founded in 1924). Both were short-lived and consequently not able to provide much institutional support for psychic investigations. The first one was seen by some of its founders as an attempt to use the scientific investigation of psychic phenomena to assist Spiritism, but it does not seem to have produced research. The second group was founded by Joaquín María Argamasilla de la Cerda y Bayona (1870–1940), known as the marquis of Santa Cara, who believed his son was a clairvoyant.[6] Graus states that, unfortunately, very little of the work of this organization was published. In fact, she suggests that the purpose of the group may have been for Santa Cara to establish his position as the main representative of metapsychics in Spain.

The Sociedad published a journal, *Revista de Estudios Metapsíquicos*, that defined the agenda of the organization as that of atheoretical experimental investigations of psychic phenomena. Announcements appeared in the journal asking the public for information about and access to individuals with psychic faculties. This reminds me of the situation at the beginning of the Society for Psychical Research in London. A letter appeared in *The Times* (of London) on Christmas day of 1883, asking for cases of various types of psychic phenomena to be sent to Edmund Gurney or to Frederic W. H. Myers (Advertisement, 1883). Similarly, the *Proceedings* of the Society also asked members to conduct thought-transference experiments, and to send information about mediums and haunted houses, as well as published accounts of psychic phenomena found in biographies and in other published sources (To Members, 1883).

Graus reminds us that, in Spain, the relationship between academic psychology and metapsychics was affected by the nascent state of the first discipline. This led some psychologists to engage in boundary work to demarcate between metapsychics and psychology. Here the author introduces the work of psychologist and Jesuit priest Father Fernando María Palmés (1879–1963), who was a strong enemy of metapsychics. "Together with psychologists such as Jastrow in the United States, he argued that only those who were experts in experimental psychology could judge the reality of spiritist phenomena and he assumed the role of guardian of scientific knowledge" regarding metapsychics and Spiritism (p. 113). His attitude, continues

Graus, shows that "psychology in Spain still was on fragile ground and struggled for its own scientific legitimacy" (p. 113).[7]

SUMMARY

Graus' book is a valuable contribution to the historiography of both Spanish psychical research and mediumship. Her discussions of the above-mentioned individuals not only enlarge our knowledge of specific investigations and ideas, but also show that the researches she focuses on were connected with what was happening in other countries.

In addition to the individuals she focuses on, Graus also rescues from oblivion other figures such as the above-mentioned Palmés. This is important because in giving space to Palmés she reminds us that the history of psychical research is not only the study of the work of proponents for the reality of the phenomena, but also includes critics, something that is not always recognized by contemporary parapsychologists.

Furthermore, she notices that there is no evidence of connections between the various research projects, or of important institutional developments, even though she mentions some organizations. The fact that their work took place outside academia did not lead the researchers to consider that their work was not scientific. They instead hoped for the development of a new field of study based mainly on the study of mediums. "In this sense, they believed that the investigation of mediums could mean an advance in scientific knowledge, and trusted that their work would one day be recognized as pioneering" (p. 116).

The author also, rightly in my view, questions the use of the term pseudoscience.

> From the historiographic point of view, to be interested in Spiritism and in psychical research is not to ask oneself what turns these fields pseudoscientific, or if they are the mere product of a fraud. The history of the so-called pseudosciences is . . . a way of getting closer to science, of understanding how knowledge functions in this context and to investigate how scientists mark their terrain and assume positions in society. (p. 117)

Furthermore, Graus sees that the persons she discussed contrib-

uted to scientific knowledge during difficult times. That is, when their topics were being highly criticized and when the "professionalization of science defined what and who formed part of a scientific domain" (p. 117).

Graus presents a valuable contribution to the history of psychical research in her discussion of the work and ideas of the above-mentioned men, individuals who have not been well-represented in the international historiography of the subject. She argues at the end of the book that she is not saying that the persons discussed in the book were eccentrics who were simply deceived by mediums. Regardless of the neglect of their work by science at large, these researchers "contributed to the production of a different kind of scientific knowledge, particularly psychological and psychiatric" (p. 117). In conclusion, Graus writes that the role of history is not to determine if a field is pseudoscientific, or if fraud is a likely explanation. In her view the history of the so-called pseudosciences is a way to approach science (p. 117).

Graus' focus on mediumship, and other phenomena, does not emphasize Otero's interest in showing the universality of psychic phenomena in the history of humankind. This is the topic of the first volume of his work *Los Espíritus* (Otero Acevedo, 1893–1895), where he discussed belief and interest in psychic phenomena in past civilizations, such as those of the Assyrians, Chaldeans, Egyptians, Etruscans, Greeks, Hebrews, Indians, Phoenicians, and Romans. Such a massive undertaking is part of a rhetorical tradition present in mesmeric and spiritualist writings to support the reality and importance of psychic phenomena by showing the universality of cases and beliefs across time and cultures (Alvarado, 2014). Otero argued that the then current trends to neglect and deny psychic phenomena show how little humanity has learned about its own history. In his view: "Known from the most remote antiquity, in the first civilizations of which news is preserved today, they have subsisted in all ages, in all times and in all peoples, because they are a manifestation of human organization" (Vol. 1, p. 29).

It should also be mentioned that the second volume of *Los Espíritus* helped to publicize in Spain investigations of various individuals from other countries. There are chapters about the work and ideas of William Crookes, Johann C. F. Zöllner, Aleksandr Aksakov, Ercole Chiaia, and Paul Gibier (Chapters 1–5, respectively). This allows us to see a further

dimension of Otero's work, that of popularizer and reviewer of the history of psychical research. A further example is a series of 12 articles that were published in the Spanish newspaper *El Heraldo de Madrid*, in which the author discussed topics such as apparitions of the living, materializations, mental suggestion, and the physical phenomena of Eusapia Palladino (Otero Acevedo, 1891).

CONCLUDING REMARKS

There are several minor inconsistencies regarding what certain authors said, and I have some disagreements with some statements, but these shortcomings don't detract from the overall value of the book, the importance of her historical study, or her conclusions. Her work is a pioneering one that I hope will inspire other research efforts in Spain. To restate, *Ciencia y Espiritismo en España, 1880–1930* not only informs us about investigative and theoretical developments in Spain that are generally unknown even to those interested in the histories of Spiritism and psychical research, but it also illuminates social aspects of that history, such as the main figures, their relation to local spiritists, and contacts with foreign figures. The study also shows the existence of Spanish theoretical ideas of pathology, the unconscious mind, and unorthodox concepts of force. All of this shows the influence of foreign concepts (mainly French), and the commonality of conceptual and methodological issues in the international study of mediumship.

NOTES

[1] For example, Spain is not represented in more recent overviews of spiritualistic and psychical research topics such as Beloff's (1993) general history of parapsychology and Moreman's (2013) anthology of articles about spiritualism and psychical research.

[2] Some examples include Abend (2004) and Balltondre and Graus (2016).

[3] The burned materials included issues of *Revue Spirite*, *Revue Spiritualiste*, and books by Allan Kardec, as well as by authors such as Ermance Dufaux, A. Grand, and Ludwig von Guldenstubbe (La Queue, 1861). In the anonymous article its author (probably Kardec),

said that it seemed a dream that the fires of the Inquisition were still burning in 1861 (p. 321). In addition, this author also wrote: "Thanks to this reckless zeal, everyone in Spain will hear about Spiritism and will want to know what it is . . ." (p. 323). Writing in a Spanish newspaper, an anonymous author considered the book-burning an indication of hypocrisy, fanatism, and barbarism (Untitled Article, 1861).

[4] In other publications Torres-Solanot (1872) recognized the value of empirical studies of psychic phenomena.

[5] Torres (1923) had previously published an article about reincarnation in which he classified cases in terms of recollections in the waking state, those that were announced via visions, dreams, and spirit communications, and those in which details were given through hypnosis and mediumship.

[6] Santa Cara's son, Joaquín María Argamasilla de La Cerda y Elio (1905–1985), received much publicity in Spain and was tested at the Institut Métapsychique International (Mülberger & Balltondre, 2013). For a prominent accusation of fraud outside of the Spanish context, see Houdini (1924). Santa Cara (n.d.) was known in Spain for his studies with clairvoyants.

[7] For a discussion of Father Palmés, see Mülberger et al. (2001). I would argue that Palmés' work represents the agendas of at least two groups. He represented psychologists and others who built boundaries between established and unorthodox knowledge regarding psychic phenomena (Brown, 1983; Coon, 1992). In addition, he was part of a tradition of Catholic (and generally Christian) opposition to psychic phenomena, sometimes labelling them as satanic. This opposition is discussed in the context of other countries by Biondi (2013, Chapter 3) and Sharp (2006, pp. 140–145). It must be clarified that not all this opposition came from the clergy, and that many members of the clergy have been positive about the existence of psychic phenomena (Nicol, 1966).

REFERENCES

Abend, L. (2004). Specters of the secular: Spiritism in nineteenth-century Spain. *European History Quarterly, 34*(4), 507–534. https://doi.org/10.1177/0265691404046545

[Advertisement]. (1883, December 25). *The Times*, p. 1.

Alvarado, C. S. (1993). Gifted subjects' contributions to parapsychology: The case

of Eusapia Palladino. *Journal of the Society for Psychical Research*, *59*(833), 269–292.

Alvarado, C. S. (2014). On constancy, stability and the antiquity of psychic phenomena. *Paranormal Review, 69*, 3–7.

Alvarado, C. S. (2019). Jules Bernard Luys on magnetic pathology (Classic text no. 119). *History of Psychiatry*, *30*(3), 359–374. https://doi.org/10.1177/0957154X19830955

Alvarado, C. S., & Biondi, M. (2017). Cesare Lombroso on mediumship and pathology (Classic text no. 110). *History of Psychiatry*, *28*(2), 225–241. https://doi.org/10.1177/0957154X16686904

Alvarado, C. S., Machado, F. R., Zangari, W., & Zingrone, N. L. (2007). Perspectivas históricas da influência da mediunidade na construção de idéias psicológicas e psiquiátricas. *Revista de Psiquiatria Clínica, 34* (supp. 1), 42–53. https://doi.org/10.1590/s0101-60832007000700007

Balltondre, M. & Graus, A. (2016). The city of spirits: Spiritism, feminism and the secularization of urban spaces. In O. Hochadel & A. Nieto-Galan (Eds.), *Barcelona: An urban history of science and modernity, 1888–1929* (pp. 136–157). Routledge.

Beloff, J. (1993). *Parapsychology: A concise history*. Athlone Press.

Biondi, M. (2013). Spiritualism in Italy: The opposition of the Catholic church. In C. Moreman (Ed.), *The spiritualist movement: Speaking with the dead in America and around the world* (Vol. 1, pp. 37–53). Praeger.

Brittan, S. B. (1851). Spiritualism: Its nature and mission. *The Shekinah, 1*(1), 1–12.

Brown, E. M. (1983). Neurology and spiritualism in the 1870s. *Bulletin of the History of Medicine, 57*(4), 563–577.

Carrington, H. (1909). *Eusapia Palladino and her phenomena*. B. W. Dodge.

Comas i Solà, J. (n.d., ca. 1908). *El espiritismo ante la ciencia: Estudio crítico sobre la mediumnidad*. F. Granada.

Coon, D. J. (1992). Testing the limits of sense and science: American experimental psychologists combat spiritualism, 1880–1920. *American Psychologist, 47*(2), 143–151. https://doi.org/10.1037/0003-066X.47.2.143

de Rochas, A. (1897). Les expériences de Choisy-Yvrec (près Bordeaux) du 2 au 14 octobre 1896. *Annales des Sciences Psychiques*, *7*, 6–28.

De Todas Partes. (1926). *Lumen, 31*(April), IX–X.

Doyle, A. C. (1926). *The history of spiritualism* (2 vols.). Methuen.

González de Pablo, A. (2006). Sobre los inicios del espiritismo en España: La epidemia psíquica de las mesas giratorias de 1853 en la prensa médica. *Asclepio, 58*(2), 63–96. https://doi.org/10.3989/asclepio.2006.v58.i2.22

Graus, A. (2015). Los prodigios del hombre encarnado: Víctor Melcior y la redefinición de la mediumnidad (1901). *Dynamis, 35*(1), 83–105. http://doi.org/10.4321/S0211-95362015000100004

Graus, A. (2016). Discovering Palladino's mediumship: Otero Acevedo, Lombroso

and the quest for authority. *Journal of the History of the Behavioral Sciences, 52*(3), 211–230. https://doi.org/10.1002/jhbs.21789

Houdini, H. (1924). *Houdini exposes the tricks used by the Boston medium "Margery" to win the $2500 prize offered by the Scientific American: Also a complete exposure of Argamasilla, the famous Spaniard who baffled noted scientists of Europe and America, with his claim to X-ray vision*. Adams Press.

Janet, P. (1889). *L'automatisme psychologique: Essai de psychologie expérimentale sur les formes inférieures de l'activité humaine*. Félix Alcan.

Méndez Bejarano, M. (n.d., ca. 1925). *Historia de la filosofía en España hasta el siglo XX*. Renacimiento.

Moreman, C. M. (Ed.). (2013). *The spiritualist movement: Speaking with the dead in America and around the world*. (3 vols.). Praeger.

Mülberger, A. (Ed.). (2016). *Los límites de la ciencia: Espiritismo, hipnotismo y el estudio de los fenómenos paranormales (1850–1930)*. Consejo Superior de Investigaciones Científicas.

Mülberger, A., & Balltondre, M. (2013). En el umbral de lo desconocido: Un caso de visión extraordinaria en la España de Primo de Rivera. *Dynamis, 33*(1), 195–216. https://doi.org/10.4321/s0211-95362013000100009

Mülberger, A., Astudillo, S., Lorente, S., & Martos, M. (2001). El Padre Palmés contra la metapsíquica: Un análisis histórico de su retórica defensiva. *Revista de Historia de la Psicología, 22*(3–4), 431–438.

Navarro Murillo, M. (1873–1874). El advenimiento de la nueva era de armonía. *Revista Espiritista, 5*(11, 12), 242–246, 257–260; *6*(1, 2, 3), 1–7, 25–32, 49–52.

Nicol, F. (1966). Clerical contributions to parapsychology. *International Journal of Parapsychology, 8*, 227–247.

Otero Acevedo, M. (1891, June 17, 22, 28, July 12, 19, 26, August 2, 9, 16, 22, 29, September 5). Los fantasmas. *El Heraldo de Madrid*, all on p. 1.

Otero Acevedo, M. (1893–1895). *Los espíritus* (2 vols.). Revista Psicológica "La Irradiación."

Podmore, F. (1902). *Modern spiritualism: A history and a criticism* (2 vols.). Methuen.

Primer Congreso Internacional Espiritista: Representaciones, adhesiones, sesiones públicas, sesiones privadas, conclusiones, documentos, etc.: Reseña completa (1888). Daniel Cortezo.

La queue du moyen âge: Auto-da-fe des ouvrages spirites à Barcelone. (1861). *Revue Spirite, 4*(11), 321–325.

Richet, C. (1922). *Traité de métapsychique*. Félix Alcan.

Santa Cara, Marqués de. (n.d., ca. 1924). *Un tanteo en el misterio (Ensayo experimental sobre la lucidez sonambúlica)*. M. Aguilar.

Sharp, L. L. (2006). *Secular spirituality: Reincarnation and spiritism in nineteenth-century France*. Lexington Books.

To members and associates of the Society for Psychical Research: Circular No.

1. (2nd ed.). On the general work of the Society. (1883). *Proceedings of the Society for Psychical Research*, 1, 295–302.

Torres, H. (1923). La reencarnación. *Lumen*, *28*(December), 309–318.

Torres-Solanot, [A.]. (1872). *Preliminares al estudio del espiritismo: Consideraciones generales respecto a la filosofía, doctrina y ciencia espiritista*. A. de San Martín.

Torres Solanot, [A.]. (1875). El movimiento espiritista. In *Almanaque del espiritismo para el año de 1875* (pp. 68–70). Alcántara.

[Untitled article]. (1861, October 16). *La Discusión*, 1.

Vilaplana Traviera, E., & Mülberger, A. (2003). Espiritismo, metapsíquica y ciencia: Análisis de tres aportaciones catalanas de principios del siglo XX. *Revista de Historia de la Psicología*, *24*(3–4), 477–488.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 405–414, 2021 0892-3310/21

ESSAY REVIEW

Has Physics Theory Become Vacuous?

Lost in Math: How Beauty Leads Physics Astray by Sabine Hossenfelder. Basic Books, 2018. 302 pp. $30 (hardcover), $17.99 (paperback), $12.99 (Kindle or Nook). ISBN 978-0-465-09425-7.

Reviewed by Henry H. Bauer

hhbauer@vt.edu; www.henryhbauer.homestead.com
College of Arts and Sciences, Virginia Polytechnic Institute & State University, USA

https://10.31275/20212015

Modern science made its mark by gaining knowledge and understanding in a bottom-up manner: starting with observed phenomena and developing explanatory theories.

From about the middle of the 20th century, however, reliance on accepted theories became increasingly dogmatic. One indication of increasing dogmatism was a failure to acknowledge phenomena for which no obvious explanation already existed—unidentified flying objects, unidentified creatures (Loch Ness Monsters, yetis, Bigfoot), parapsychological phenomena. Dissatisfaction with ignoring such phenomena led to the founding of the Society for Scientific Exploration as well as other, typically more topic-specialized, groups. A further indication of increasing dogmatism was the continuing adherence in many mainstream matters to explanations no longer consonant with accumulating evidence (Bauer, 2012a).

Nevertheless, it continues to be widely believed that science is carried on, and should be carried on, as described by the scientific method: The validity of theories is judged by their adequacy in explaining observable facts.

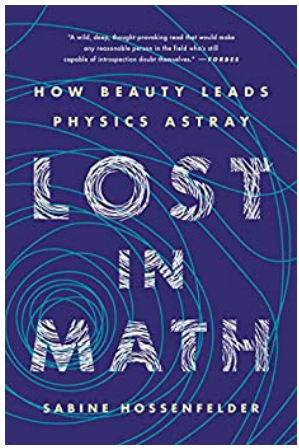
Lost in Math argues that theoretical physics is no longer a science

in this sense, that it has become a playground of purely mathematical speculation, with judgments of potential validity made not by appeal to observables but to such aesthetic values or principles as elegance or beauty.

The book is enormously informative, extremely well-written, highly recommendable. Honestly and with full disclosure, Sabine Hossenfelder describes in the first person her grappling with the dilemma that her profession, theoretical physics, appears to be determinedly wrong-headed, at an impasse, a dead end, going nowhere, for instance producing 193 models for the early universe and 500 theories to explain a spurious signal (p. 235).

All the observed phenomena of fundamental particle physics and of cosmology appear to be explainable by quantum mechanics, special and general relativity, and the "standard model" that features just 25 particles.[1] However, there is no single mathematical formulation that encompasses all physical phenomena. In particular, gravitation and quantum mechanics are separate theories. Yet the community of theoretical physicists believes—takes it on faith—that there must be a single unified mathematical system from which all current theories can be derived; and for perhaps as much as half a century, theoreticians have attempted, without success, to find such a unified Theory of Everything (TOE)—as Albert Einstein had tried, also without success, for the last several decades of his life.

The Quest is based purely on faith because it lacks guidance from empirical fact. In the past, new theoretical developments came about in order to codify previously unexplainable phenomena. Lacking such clues, the quest for a TOE is being guided by beliefs about what properties the ultimate theory should have: simplicity, naturalness, symmetry, elegance, beauty. All those exist in the eyes of beholders rather than in any objective characteristic of mathematics or of observable reality, however, and defy objective definition. Hossenfelder gives splendidly understandable explanations for what those terms mean to the theorists, for example "symmetry" (pp. 23–26), "beauty" (p. 26 ff.), "naturalness" (pp. 91–94), "elegance" (pp. 94–95). She points out that inspiration or guidance by such intuitions did lead to some genuine advances in the past, but that they have also often led theorists astray (pp. 32–33).



String theory is also described lucidly (pp. 172–76), as are black holes (pp. 182–185). Readers further learn of particles that they have probably never heard of before: preons, sfermions, dyons, wimps, wimpzillas, cornucipons, cuscutons, and many more; even "unparticles" (p. 198).

Lost in Math narrates Hossenfelder's conversations with theoretical physicists seeking to clarify whether indeed the whole profession, including its leading lights, has abandoned the traditional scientific approach of aiming to understand and explain empirical, observable, phenomena. Reading the book is like getting a one-on-one, in-person tutorial, from a first-rate teacher who is not only master of the technical subject but also firmly grounded in common sense, as well as skilled at explaining technical issues to outsiders. Most readers will not need to take notes because each chapter concludes with a section "In Brief" that summarizes the chapter's main points.

The book also offers well-founded insights into the circumstances of contemporary science as a whole.

My enthusiastic praise for this book is echoed by many reviewers.[2] Perhaps the most meaningful compliments come from members of the physics community itself (e.g., Appell, 2018), especially those who disagree with Hossenfelder on various specific points: "Although I disagree . . . on many points, I recommend the book both as a well-written, moving intellectual autobiography and as an excellent exposition of some frontiers of foundational theoretical physics" (Wilczek, 2018); a philosopher of science remarks, "I first state my main disagreements. Then, I mostly praise the book" (Butterfield, 2019).

Hossenfelder exemplifies the ideal scientist: self-driven[3] to seek genuine understanding. That is not nowadays a promising career path, as Hossenfelder is fully aware: "Several well-meaning friends have tried to dissuade me from writing this book" (p. 197). Fortunately, she ignored this advice, but a price is being paid: "Hossenfelder has had a nomadic career of short-term research positions, but it would be good if she could find a permanent home and some security. Today's

theoretical physics needs a few malcontents asking questions that other scientists only ask themselves" (Appell, 2018). Indeed, science as a whole sorely needs more dedicated truth-seekers willing to overcome conflicts of interest and pressures from peers and patrons and employers. As George Bernard Shaw noted, progress depends on unreasonable people[4]—individuals regarded as unreasonable by their peers because they refuse to capitulate to conformity and Groupthink; say, Hossenfelder re theoretical physics; Peter Duesberg, Kary Mullis, and others re HIV/AIDS, and other mavericks, cited for example in Bauer (2012a). Anyone interested in benefiting from Hossenfelder's work and ideas can do so at her well-regarded blog, http://backreaction.blogspot.com.

The first three chapters of *Lost in Math* are a historical survey of advances in fundamental physics up to the present. Most of the rest of the book relates interviews with leading theoreticians that accumulate to make a convincing case for Hossenfelder's views. There is simply no sound reason to expect that subjective feelings of beauty or elegance, or "Eureka" moments of exhilaration, would be a reliable indication of having found genuine understanding of the real world: "Why should the laws of nature care what I find beautiful?" (p. 3); "Science is an organized enterprise to overcome the shortcomings of human cognition and to avoid the fallacies of intuition" (p. 4).

Predictions that new effects would be seen in upcoming experiments have been wrong time and again without destroying faith in the basis for making the predictions (p. 94), reminiscent of End-of-the-World cults that continually revised their calculation of the apocalyptic date instead of abandoning the disproven basic assumption (Festinger et al., 1956).

A prize-winning physicist defended reliance on experienced intuition by analogy with poker: "A royal flush is just as likely or unlikely as any other hand. But there is still something about a royal flush that cries out for an explanation if you get three in a row" (p. 111). As Hossenfelder points out, that some striking coincidence attracts human attention does not mark it as an insight into Nature's realities; humans including physicists tend to assume that coincidences must be meaningful (p. 144), yet they may come about purely by chance, given the large number of opportunities (Bauer, 2019).

Hossenfelder writes with dry humor as well as passionately: "This is possibly the nicest way I've ever been told I'm stupid" (p. 177). When physicists base theories on something other than facts, "the thought makes me sweat" how climate scientists might choose their models (p. 34).[5] After interviewing a prominent fellow theoretician, "I understand why he has become so influential. In contrast to me, he believes in what he does" (p. 85). "Theoretical physicists used to explain what was observed. Now they try to explain why they can't explain what was not observed" (p. 108); as when they report their results as finding "interesting bounds": "In plain English, 'interesting bounds' means they didn't find anything" (p. 201).[6] "String theorists' continuous adaptation to conflicting evidence has become so entertaining . . ." (p. 174); "Why are so many jobs offered in string theory? Because string theory is cheap. . . . offer a couple of jobs in string theory and you have a modern physics department" (p. 174).[7] "In case I left you with the impression that we understand the theories we work with, I am sorry, we don't. We cannot actually solve the equations of the standard model, so what we do instead is solve them approximately by what is known as 'perturbation theory'" (p. 193). "This isn't the only math problem with the standard model or quantum field theories more generally. Another such problem is Haag's theorem, which states that all quantum field theories are trivial and physically irrelevant. That's somewhat disturbing, so physicists ignore the theorem" (p. 268, #22).

The book's concluding Chapter 10 encompasses a concise yet comprehensive description of the many forms of bias that are inherent features of human nature and that explain how human beings can go wrong individually, as well as in groups under the influences of peer pressure and Groupthink. Thus, experimenters may subconsciously try to replicate earlier work (p. 227 ff.). "The mother of all biases" is "the insistence that we certainly are not biased" (p. 231).[8]

This chapter should be read by everyone, quite independently of any interest in theoretical physics. Hossenfelder had noted earlier the human tendency to appreciate things that are new and surprising *but not too much so* (p. 89). I suspect she is not however familiar with the mass of literature on minority views and unorthodoxies that is the foundation and background of anomalistics and scientific exploration; for example, in the book's discussions of dark matter and dark energy

I looked in vain for reference to the work of Halton Arp (1987, 1998)—because if Arp is right, that some redshifts associated with quasars are not a purely Doppler Effect, then current calculations of cosmic distances and speeds are wrong and there may be no need to postulate those "dark" things.

Beyond the inevitable biases, contemporary science can go wrong because of its sheer growth. It is nowadays far from an elite vocation, and research is also hindered by the intractable volume of the specialized literature as well as career uncertainties and competition for resources (pp. 153–56, 170). "Almost all scientists today have an undisclosed conflict of interest between funding and honesty" (p. 197). "In the United States, the income inequality in academia is now larger than in industry or government" (p. 269, #2 citing Lok, 2016).

Appendix C (pp. 245–248) suggests how science might again be made to behave as an unbiased, disinterested, truth-seeking enterprise. Unfortunately, this is far from convincing. Hossenfelder's own experience, and this book, and other critiques of contemporary science (Bauer, 2017b; Ritchie, 2020) show clearly enough that the fundamental problem is that researchers are not independent self-supporting entrepreneurs and can pursue research only with resources made available by patrons, typically private or governmental institutions; and those resources are coupled to incentives that are not primarily to seek reliable truths about nature. Those incentives are what lead science astray, emphasizing productivity measured in publications or in commercial applications and making necessary a never-ending competition for resources; there is "a natural selection for bad science" (Smaldino & McElreath, 2016).

Lost in Math naturally stimulates a certain curiosity as to why society should support for decades a venture that will almost certainly result in no useful practical benefits. I suspect the answer is that physics has managed to keep the enormous prestige and status attained as a result of technical developments during World War II, most especially atom bombs and nuclear power reactors.[9] But it seems quite inconceivable that any future theoretical advances could have anything like the consequential practical impact as did $E = mc^2$. Why then should society provide a living for some 10,000 theorists (p. 1) and continue to build enormously expensive machines? The Large Hadron Collider at

the international European Organization for Nuclear Research (CERN) in Switzerland costs about 1 billion dollars a year just to run; the last discovery made there, the Higgs boson, is estimated to have cost more than 13 billion dollars.[10] It seems much more likely that socially useful advances could come from areas that are currently dismissed as fringe science, say the harnessing of Zero Point Energy (Yam, 1997) or Low-Energy Nuclear Reactions ("cold fusion").[11]

Anyone interested in higher education might well be led also to consider whether the old model of research universities may have outlived its social value. Does it make sense that ground-breaking original research should be demanded of everyone whose purported primary role is actually the "higher" education of future generations?[13] That is a whole other story, of course, and volumes have been written about it elsewhere, for instance concerning postmodernist excesses like "critical theory" and infatuation with French philosophers that captured Departments of English Literature a couple of decades ago.

So Hossenfelder's book is not only a wonderful exposition of contemporary theoretical physics, it also stimulates thought on other and more general topics of present-day concern.

NOTES

[1] 12 fermions (6 leptons and 6 quarks), 12 gauge bosons (Z, W^-, W^+, 8 gluons), and the Higgs boson.

[2] More than a dozen favorable blurbs are gathered at https://www.revolutionbooks.org/book/9781541646766.

Ratings at Goodreads averaged 4/5, and 4.6/5 at amazon.com. As to those latter reviews: I've taken an interest in the significance, uses, and abuses of unsolicited as well as anonymous comments ever since my experience of anonymous student evaluation of teachers ("The new generations: Students who don't study"; http://faculty.tamucc.edu/dcrumbley/Crumbley%20Homepage/students-who-dont-study.html). I've always remembered, too, the tour guide who solicited written evaluations after our tour ended. I asked whether the company shared these with her, and she replied, "Yes. But now I no longer read them, because no matter how many nice ones there are, the one or two really nasty ones are what stay with you and sour you on your next clients."

The 380 reviews on Amazon of Hossenfelder's splendid book provide similar insight into the routine presence of a proportion of the ignorant or malicious commentary that fouls the Internet. Just under 10% of the Amazon reviews of *Lost in Math* were less than very favorable (less than 4/5). One very lengthy 2/5 review is by a prolific non-anonymous individual whose 46 reviews of books and other products averages 2.45 while all other reviewers gave those an overall average rating of 4.0.

[3] By contrast, the mass of research is nowadays done by people whose curiosity is not self-driven but rather *induced* by career opportunities and money—Gordon Tullock, *The Organization of Inquiry*, Duke University Press, 1966 (reprinted 2004, Liberty Fund). My eight years as a dean of arts and sciences (Bauer, 2012b) confirmed Tullock's observation: Most of the faculty viewed research as an obligation rather than a vocation; thus a sociologist once asked me, "Now that I've reached full professor, what remains for me to do?"

[4] George Bernard Shaw, "Reason," in "Maxims for Revolutionists," pp. 281–282 in the 1946 Penguin edition of *Man and Superman*.

[5] In fact, climate scientists are indeed much like theoretical physicists in putting theory ahead of facts: They attempt to create computer models of climate while ignoring long-standing facts in the geological literature that demonstrate a lack of correlation between levels of atmospheric carbon dioxide and global temperatures (Bauer, 2017a).

And economics, it turns out, is also in much the same boat as theoretical physics: "economists . . . mistook beauty, clad in impressive-looking mathematics, for truth," according to Paul Krugman (p. 224).

[6] Just as medical scientists pretend to knowledge and understanding when they speak of "essential" tremor and "idiopathic" conditions when the causes are unknown or nothing can be done about it.

[7] Citing Freeman Dyson, 2009, Birds and Frogs, *Notices of the American Mathematical Society*, 56(2), 221. An old joke has a dean boasting about saving money by growing the math department: "All they need are paper, pencils, and wastebaskets"; which is topped by a dean who favors sociology: "They don't even need wastebaskets."

[8] Illustrated for instance when researchers claim objectivity because of using "the scientific method."

[9] The credit has somehow accrued to physics, perhaps because of Einstein and $E = mc^2$, even though it was chemistry that first recognized nuclear fission, and the atom-bomb project was a multi-disciplinary effort involving, as well as physicists, mathematicians, engineers, chemists, and far from least maestro administrators—one of whom was indeed also a physicist.

[10] Alex Knapp, How much does it cost to find a Higgs boson?, July 5, 2012, *Forbes*. https://www.forbes.com/sites/alexknapp/2012/07/05/how-much-does-it-cost-to-find-a-higgs-boson/?sh=2c8372703948

[11] See "A library of papers about cold fusion." https://lenr-canr.org

REFERENCES

Appell, D. (2018, September 12). The trouble with beauty. *Physics World*. https://physicsworld.com/a/the-trouble-with-beauty

Arp, H. (1987). *Quasars, redshifts and controversies*. Interstellar Media.

Arp, H. (1998). *Seeing red: Redshifts, cosmology and academic science*. Apeiron.

Bauer, H. H. (2012a). *Dogmatism in science and medicine: How dominant theories monopolize research and stifle the search for truth*. McFarland.

Bauer, H. H. [writing as Josef Martin] (2012b). *To rise above principle: The memoirs of an unreconstructed dean* (2nd ed., with added material). Wipf & Stock. (1st ed., University of Illinois Press, 1988).

Bauer, H. H. (2017a). Climate-change facts: Temperature is not determined by carbon dioxide. *Skepticism about Science and Medicine*. https://scimedskeptic.wordpress.com/2017/05/02/climate-change-facts-temperature-is-not-determined-by-carbon-dioxide

Bauer, H. H. (2017b). *Science is not what you think: How it has changed, why we can't trust it, how it can be fixed*. McFarland.

Bauer, H. H. (2019). Random coincidence or psi: What are the odds? *Zeitschrift für Anomalistik*, *19*(1 & 2), 140–150.

Butterfield, J. (2019). Review of *Lost in math: How beauty leads physics astray* by Sabine Hossenfelder. *Physics in Perspective*, *21*, 63–86. Hossenfelder's detailed response is at http://backreaction.blogspot.com/2019/02/a-philosopher-of-science-reviews-lost.html

Festinger, L., Riecken, H. W., & Schachter, S. (1956). *When prophecy fails: A social and psychological study of a modern group that predicted the destruction of the world*. University of Minnesota Press.

Lok, C. (2016). Science's 1%: How income inequality is getting worse in research. *Nature*, *537*(7621), 471–473.

Ritchie, S. (2020). *Science fictions: How fraud, bias, negligence, and hype undermine the*

search for truth. Metropolitan Books (Henry Holt).

Smaldino, P. E., & McElreath, R. (2016, September 1). The natural selection of bad science. *Royal Society Open Science*, 3, 160384. https://doi.org/10.1098/rsos.160384

Wilczek, F. (2018). Has elegance betrayed physics? *Physics Today*, 71(9), 57. https://doi.org/10.1063/PT.3.4022

Yam, P. (1997, December). Exploiting zero-point energy. *Scientific American*, 277(6), 82–85. https://www.jstor.org/stable/10.2307/24996046

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 415–416, 2021 0892-3310/21

BOOK REVIEW

Sensitive Soul: The Unseen Role of Emotion in Extraordinary States by Michael A. Jawer. Park Street Press, 2020. 256 pp. ISBN 978-1644110829.

Reviewed by Robert S. Bobrow

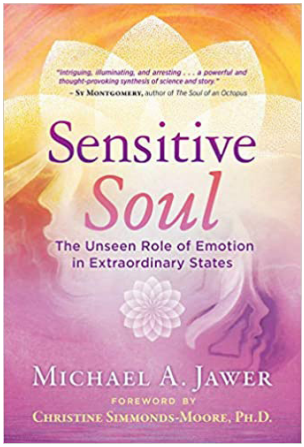
Robert.Bobrow@stonybrookmedicine.edu
Stony Brook University, USA

https://10.31275/20212005

Strong emotions underlie many telepathic events. Brain waves, the basis for electroencephalography, were discovered by Dr. Hans Berger after he suffered a serious accident and his sister, hundreds of miles away, who could not have known about this, sent a telegram to ask if he was okay. Attempting to figure out how this could have happened, Dr. Berger ultimately recorded the first brain electrical activity, from his son. Similarly, a wife bolts upright from a deep sleep the moment her husband is killed in battle, on another continent. A murder victim's life is later remembered by a child, unrelated and totally removed from the event. A lecturer suddenly experiences a pain in his knee so severe that he cannot continue his talk; simultaneously, it turns out, his twin brother has been hit in the leg by a car.

Emotions are instinctive and form the core of human nature. Michael A. Jawer, the author of *Sensitive Soul*, sees them as a "fundamental binding source" that connects humanity and makes the world turn. He applies this thesis to a wide range of medical and paranormal topics. Post-traumatic stress disorder is seen as an emotional sensitivity rather than a pathology. Migraines can be precipitated by emotions. Autism is seen as an engulfing and terrifying bombardment of the senses. Emotional stress may modify genes, via epigenetics, allowing transmission of fear across generations.

Also covered is a wide range of phenomena that are incompletely understood. Mirror senses (based in part on the discovery of mirror



neurons), synesthesia—the ability that some people have to blend the five senses such as seeing colors when hearing sounds, out-of-body experiences, dissociative disorders, child prodigies, and environmental sensitivities. And animals. A chimpanzee enjoys a beautiful sunset, a dolphin is aware that someone on a nearby ship has died. Jawer feels that strong emotional content drives these examples.

While emotional reactivity causes some seemingly paranormal events, like telepathy, it can also result from them, or simply accompany them—the reader can position the cart and the horse. I've known very emotional people who aren't telepathic, and some stolid folks who are. While about 70% of the American population holds some paranormal belief, a much smaller fraction actually experience these events, and an even smaller minority experience them regularly. Jawer considers this last group to be "thin boundary" people, penetrable by the strong emotions of others, even at great distances. Jawer's theses are consistently interesting, and *Sensitive Soul* is a consistently interesting book, particularly in the very wide range of topics it covers, some of which I mentioned above. The work is scholarly and well-referenced, never boring, and very up-to-date on things that intrigue us. It belongs on your bookshelf.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 417–421, 2021 0892-3310/21

BOOK REVIEW

An Extraordinary Journey: The Memoirs of a Physical Medium by Stewart Alexander. White Crow Books, 2020. ISBN 978-1-78677-137-7 (paperback), ISBN 978-1-78677-138-4 (ebook).

Reviewed by Zofia Weaver

zofiewe@ntlworld.com

https://10.31275/20212053

This is a revised and updated version of Alexander's book published in 2010 under the same title. The changes are minor; there are some additional reflections on the subject of Spiritualism by the author, but mainly they consist of supplementary accounts from sitters who have taken part in séances with Alexander since the original publication. Some appear in chapters described as "seminars," reported chronologically, but in fact they are also witness accounts of séance experiences. The most significant addition, in terms of reporting startling new phenomena, is the Epilogue provided by American journalist and author Leslie Kean. There is no index.

I found this book very readable. Also, having read it, I would find it difficult to disagree with the descriptions of Alexander by the late David Fontana (who provided the Foreword) and Annette Childs (who provided An Appreciation) as a person of integrity and dedication, as well as intelligence and good humor; in fact, "a true gentleman" (p. xxiii).

Alexander, together with his brother, became a Spiritualist after reading, in the early 1970s, *On the Edge of the Etheric*, first published in 1931. That book, by J. Arthur Findlay (a Scottish businessman who had an important influence on the development of the spiritualist movement), provides a theory of the spirit world based on the evidence of mediumship.

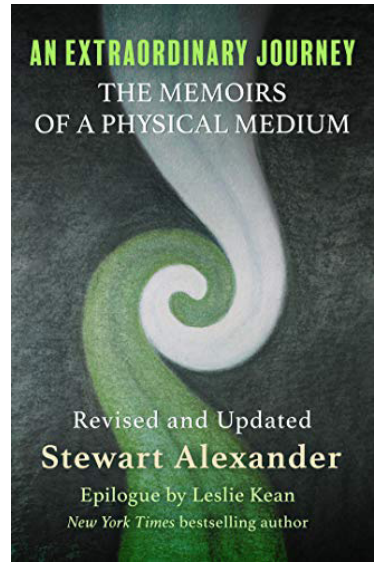
One can only admire the tenacity with which Alexander, having

become convinced of the reality of that spirit world, sought contact with it through the experience of mediumship. Spiritualist churches were a disappointment, offering semi-religious services with mediumship tacked on, while sitting in a variety of private home circles produced nothing but endless "evenings of bewilderment and embarrassment" (p. 5). Two years later Alexander started a home circle of his own, and even though he had not set out to become a medium he eventually had an experience "like merging with a presence" (p. 10), which turned out to be his guide, White Feather. However, the experience was initially frightening and uncomfortable, as well as questionable as to its nature: Could it be a secondary personality?

Altogether it took a number of encounters with other mediums and something like 14 years for Alexander to achieve demonstrable mediumship, with total trance, voice phenomena coming through with messages, and intricate movements of trumpets—the little metal cones that usually feature in traditional physical mediumship séances. Even when his circle matured into a coherent dedicated body with the right mix of people, there were more blank sittings than good ones.

The story of Alexander's mediumship is interspersed with those of other mediums, some told to him by other people; they are second- or third-hand accounts from different periods, and with different perspectives on well-known mediums such as Alec Harris, Helen Duncan, Minnie Harrison, and George Valiantine, as well as those who never entered public life. And since Alexander's own development as a medium involved very closely his family and friends, such as his circle leader Roy Lister, it is also at times a very personal story, but never a gossipy one.

Alexander's séances, which by now have been going for many years and been held at a number of venues, sound very traditional. They take place in darkness, with a cabinet for the medium, and with trumpets which during séances move through the air. Luminous tabs are placed on the medium's knees, the cabinet curtains, and the trumpets. The numbers of sitters vary—it seems up to about a dozen. The medium sits in an armchair, his wrists strapped to the arms of the chair with plastic cable ties. There is also a table with a translucent red top that can be illuminated by an adjustable light within it. After the opening prayer and music, White Feather, Alexander's control, speaks through



him. A small number of regular "spirit communicators," with their individual voices and personalities, help put sitters at their ease and communicate with those in the spirit world. This is usually followed by a demonstration of "matter through matter" phenomenon, where Alexander's hand, held up by an invited sitter, is seen to be free of the cable tie and then witnessed to be secured again to the arm of the chair. Another demonstration of materialization/dematerialization involves a blob of ectoplasm appearing on the illuminated translucent tabletop and forming into a hand. The invited sitter, sitting at the table across from the medium, puts her hand on the table and is able to touch the hand, which then withdraws and melts away.

Many of the reports quoted in the book provide additional interesting details, but the above summary is based on an article which appeared in the *Paranormal Review* (Sutton, 2009), a quarterly published by the Society for Psychical Research, summarizing Alexander's séance procedures and phenomena. It is reproduced by Alexander in the chapter titled *An Academic Treatise* (pp. 123–137). The article's author makes the comment that the conditions would not satisfy "outright sceptics" (p. 124); it seems to me that even open-minded skeptics might have problems taking the phenomena at face value when the conditions are fully controlled by the medium. At this point one might speculate about possible ways and motives for producing the phenomena by normal means, disregarding the numerous witness reports that point, at the least, to remarkable feats of clairvoyance and psychokinesis. One could also express regret about Alexander's reluctance to take part in scientific investigation. However, the latter becomes easier to understand if one looks at the phenomena in light of the nature, consistency, and strength of Alexander's beliefs.

As I interpret his story, for Alexander the spirit world is totally real.

His aim is to demonstrate to the world the existence of that other, spirit world, through the evidence of physical mediumship. He is well-aware of mediums' tricks and sitters' delusions, he has sympathy with the skeptics, but his sittings are not aimed at convincing investigators or doubters, which he regards as pointless. His refusal to participate in experiments with infrared or thermal imagery may have been the reason why in the 1990s he parted company with the Noah's Ark Society, devoted to promoting physical mediumship, of which he had been a prominent member. There may have been concerns about the dangers of such technology, but his main aim throughout has been to provide a link between this world and the spirit one, guided by his spirit communicators. This could well be inhibited by trying to fit in with test conditions imposed by outsiders. He also has a valid point when he questions whether participating in tests, or producing a film of his séances, would do anything to promote belief in the phenomena.

He can be quite scathing about today's Spiritualism, with its services and demonstrations, that "gives the message that Spiritualism rests upon a system of belief rather than demonstrable factual evidence of survival beyond the grave" (p. 257). It seems that what especially appeals to him are the accounts of some fairly controversial mediums, the most important one being Mina Crandon, to whom he devotes two chapters. Presumably it was his interest in her that encouraged the emergence during the séances in 1992 of Walter Stinson, Mina's brother, who died in 1911. Since then Walter has been taking charge of the physical materializations and it is his materialized hand that the sitters grasp on the illuminated table.

With Alexander, we do not get powerful and varied displays like those of D. D. Home, Stainton Moses, or Franek Kluski. He did not set out to be a medium, and his phenomena are controlled by the "spirit people" and are comparatively limited in range. However, they have steadily developed over the years and in 2000 the Spirit team was joined by Dr. Franklin Barnett, a fully materialized entity that interacts with the sitters, touching them and walking among them. From the Epilogue by Leslie Kean we learn that sittings can now take place via an iPad when she is in America, with successful book tests (where the otherworldly communicator directs the sitter to a particular book, line, and page to find a particular word) and a variety of anomalous events.

Alexander makes clear his commitment to the worldview where spirit communicators are real and influence events at the séances. His witnesses over the years give very similar accounts of their experiences. It seems that the current sitters are mostly known to each other and deeply committed and, whatever the nature of the phenomena, the emotions, elation, and sense of wonder are real.

Steve Hume, who reviewed the original version of the book for the *Journal of the Society for Psychical Research*, had the benefit of not only attending Stewart Alexander's séance, but being in the séance room right up to the sitting itself (setting up microphones). He was certain that there were no wires attached to the trumpets, and that no wires or accomplices could have produced the phenomena he witnessed (Hume, 2011).

So perhaps Alexander has the right formula: his own empathetic personality and strong belief, and a cohesive group of dedicated sitters; conducive conditions helped by the darkness and not inhibited by tests that might dampen the enthusiasm; there is also the immediate feedback that strengthens belief, which then cumulatively builds up in repeated séances. His sittings accord well with Batcheldor's formula for sitter-group success, and with his view that, "The sitter group can be construed as a creative situation in which firm beliefs—whatever form they may take—will largely shape and determine the results" (Batcheldor, 1984, pp. 109–110). The vast literature on physical mediumship and materializations of the past takes us into a world where some people seem able to conjure up their own physical realities, whatever else might be involved. Alexander's book offers one interpretation of such a world, one that works for him and his sitters. It also makes for instructive and entertaining reading for those interested in mediumship in general and physical mediumship in particular.

REFERENCES

Batcheldor, K. J. (1984). Contributions to the theory of PK induction from sitter-group work. *Journal of the American Society for Psychical Research, 78*, 105–122.

Hume, S. (2011). *Extraordinary journey* by Stewart Alexander [book review]. *Journal of the Society for Psychical Research, 75*(3), 151–153.

Sutton, L. (2009). Contemporary physical mediumship. Stewart Alexander séances. *Paranormal Review, 51*, 14–20.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 422–432, 2021 0892-3310/21

BOOK REVIEW

Science Fictions: How Fraud, Bias, Negligence, and Hype Undermine the Search for Truth by Stuart Ritchie. Metropolitan Books (Henry Holt), 2020. 353 pp. $29.99 (hardcover). ISBN 978-1250222695.

Reviewed by Henry H. Bauer

Virginia Polytechnic Institute & State University
hhbauer@vt.edu; www.henryhbauer.homestead.com

https://10.31275/20211975

This book does a splendid job of describing and documenting the dysfunctional features of contemporary science mentioned in the book's subtitle. Were I still teaching, I would have my students read this book as the basis for many productive class discussions. The margins of my copy overflow with notes, comments, and cues for further reading. The 80 pages of endnotes, for some 260 pages of text, are the best and most interesting documentation that I can recall ever finding in such a book. At any rate, I recommend this book wholeheartedly; I doubt that anyone interested in the nature of contemporary science will fail to be informed and to find stimulation for further thought and reading.

The Preface already promises that this will be a page-turner. Many will be astonished and disheartened by the fully documented cases of outwardly distinguished academics whose work was largely or completely fraudulent, as with Diederik Stapel (pp. 4–5 and later).

Ritchie quite appropriately sees replication as the essence of science (p. 5): "If it won't replicate, then it's hard to describe what you've done as scientific at all." Note that this is an *empirical* statement, not the Popperian criterion that theories must be falsifiable in principle if they are to be regarded as scientific. If a claimed observable phenomenon cannot be repeated, then we cannot know that it was real, that it happened even once, when first claimed. That's the continuing dilemma

for parapsychology, cryptozoology, for anomalistics in general. Ritchie points out that the scientific community failed to handle appropriately the issue of replication in the case of Stapel, and also with Daryl Bem's claimed evidence of precognition. Overall, peer review and journal publication practices have not saved science from "a dizzying array of incompetence, delusion, lies, and self-deception" (p. 7).

Part I of the book, "Ought and Is," illustrates that science does not work as we think it should, for the most fundamental reason that scientists are human beings engaged in a social activity (Chapter 1, How Science Works; Chapter 2, The Replication Crisis). Science is socially constructed, as is often said, but only in the sense that the subjective inputs from individuals interact to yield something more objective, or at least less subjective (p. 14).

Unwarranted dogmatism pollutes science. The book, *Thinking Fast and Slow*, whose author Daniel Kahneman had won a Nobel Prize for economics, garnered almost universal rave reviews, but half a dozen years later, Kahneman confessed that he had been wrong in describing studies of priming as being unquestionably true (p. 28). "Power posing" was another fad widely greeted as an important psychological insight, promoted by "the second-most-watched TED talk ever" and a best-selling book (p. 29) before being debunked. So too with the Stanford Prison Experiment and the studies of obedience by Stanley Milgram, which continue to be widely cited by pundits and others who have not become aware of how badly flawed these studies were (pp. 29–30). The trouble is that once the media have welcomed as true an important claimed discovery, it continues to be mistakenly taken to be true by huge swaths of society: The debunking never gets as enthusiastic and prominent coverage as the initial claims of remarkable discovery. "The studies that failed to replicate continue to be routinely cited both by scientists and other writers: Entire lines of research, and bestselling popular books, were being built on their foundation" (p. 32); and "these are just the ones we know about" (p. 34). The lack of replication pervades science as a whole, but it is most troublesome for society on matters of medical research and practice (p. 38 ff.).

Part II of the book gives details of "Faults and Flaws": Chapter 3 on fraud, Chapter 4 on bias, Chapter 5 on negligence, and Chapter 6 on hype. These details should be read by everyone, and should be required

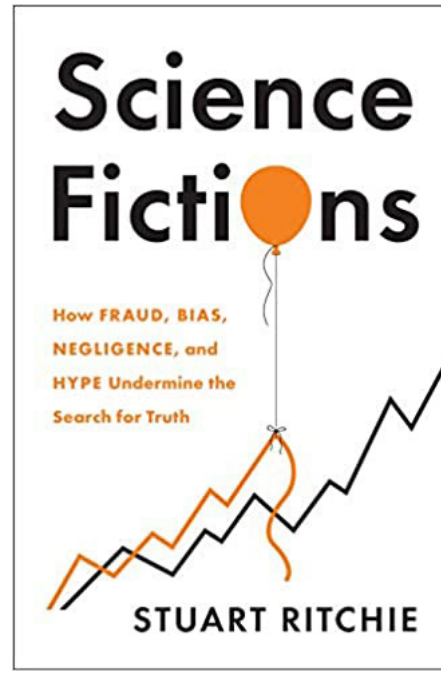
reading for all scientists, researchers, and physicians.

As to fraud, it is chilling and hair-raising to read of the failure of so distinguished an institution as Sweden's Karolinska Institute to deal with dishonest medical practices in its own bailiwick: artificial tracheas that damaged innumerable people (p. 48 ff.). Ritchie makes the excellent point that science's long record of trustworthiness "might, perversely, be what prevents it from spotting the bad actors in its midst" (p. 54). The very top journals, *Science* and *Nature*, had published fraudulent claims about cloning and about induced pluripotent (~stem) cells. It seems virtually inevitable that many *yet undiscovered* instances of deliberate fraud are present in less prestigious publications (p. 60). In that connection it should be noted that is there is a continuing spate of "predatory" journals established that ask authors to pay "processing" charges for prompt, supposedly peer-reviewed publication online, so that the publications are available to everyone, whereas the long-established professional journals are available only to people with access to academic and research libraries or to those who are prepared to pay not-insignificant amounts for individual published articles. The situation here is somewhat muddied as more and more of the traditional professional journals also offer authors the option of paying to have their articles immediately available online as "open access" on the journals' websites (p. 219).

Distinguishing fraud from honesty and genuine reports is complicated by the fact that bad actors can sometimes achieve genuine accomplishments: Woo Suk Hwang, the well-regarded Korean researcher who perpetrated many frauds including the claim of cloning a human embryo (p. 55), did in fact succeed in cloning an Afghan Hound (p. 57).

When statistical analysis is fundamentally involved, there are several approaches to detecting fraud; for example, "If a dataset looks too neat, too tidily similar across different groups," or if there are too few missing data-points (p. 63), or if the distribution of numbers might not be what is mathematically expected (p. 64). A lengthy endnote describes Benford's law, an empirical fact for which there seems to be no satisfactory explanation, that "the first significant digit of the numbers in many data sets is far more likely to be low than high" (p. 275).

A general reason why fraud in science is so unexpected is it that



the motives seem inscrutable. Thus, Ritchie describes a case in which it would have been easier for the perpetrator of fraud to have actually carried out the study rather than doing the intricate work needed to carry out the fraud (p. 65). In some cases it may be that a fraud reflects the perpetrator's utter belief that his views are correct and that producing the needed data would just be too much trouble (p. 71).

At any rate, the book is spot-on in pointing out how widespread and deep the damage can be from fraud, tarnishing the reputations of many innocent colleagues and polluting the scientific literature for a long time, because retractions do not become quickly or universally known so that fraudulent articles continue to be mistakenly cited as trustworthy (p. 74 ff.)

Chapter 4 grapples with the subtle, insidious factor of bias, which is a universal human trait. One source may be the desire to get clear, exciting results to support a pet theory, or to defeat a rival's claims (p. 83). Another is certainly the emphasis on publishing positive results only. This has the disadvantage that failed attempts to replicate published work are hidden from view (the so-called file-drawer problem), whereby work that cannot be replicated may continue to be cited as though it were meaningful. That is indeed a problem, but the suggestion that publication should be based not on the results of a study but on the soundness of its methodology (p. 85) may go too far; most people, after all, are interested in learning only of noteworthy results, and it is entirely rational for a journal to publish only what it believes may attract subscribers and readers.

Ritchie gives an excellent explanation (p. 86 ff.) of the need for some

objective criterion for deciding whether a given result is meaningful or only accidental. The widely used "$p \leq .05$" criterion is arbitrary as well as quite weak; usually the effect size is more usefully meaningful, and it is also important to note the size of the sample being tested. The explanation of meta-analysis is also excellent, including a discussion of the use of funnel plots to detect possible publication bias: Such bias can distort the literature because published work will be slanted toward large effect sizes. That can be particularly damaging in medicine, by misleading as to the appropriate use of biomarkers (p. 94) and the efficacy of drugs (p. 95).

The book does not cite the popular saw that "there are lies, damned lies, and statistics," or the version that "one can prove anything by statistics"; but several examples are given of how inappropriate or incompetent statistical analysis brings misleading publications into the literature. One way is through "*p*-hacking": Since the criterion of $p \leq .05$ is so vital for getting articles published, all sorts of fudging may be used to bring results below that level (p. 99). That this is quite common is suggested by studies that found a remarkably high proportion of published articles with *p*-values *just* below .05. A perhaps more subtle misdeed is HARKing, **H**ypothesizing **A**fter the **R**esults are **K**nown: If the original hypothesis is not substantiated, the data are searched for *any* significant correlation, and the article later submitted for publication pretends that this was the original hypothesis; .05 is 1 in 20, so one is likely to find an apparently significant correlation for every 20 attempts. Another pitfall for the unwary is *overfitting* of the data to an empirical curve (p. 108).

A variety of inappropriate or incompetent statistical approaches abound in the literature, found for instance even in the work of Brian Wansink, who had achieved more than nearly three decades of a truly distinguished career status (p. 98), until independent analyses of the data led to his resignation (p. 102). Clinical trials in medicine are increasingly suspect since they are paid for by self-interested drug companies (p. 110 ff.). "You might wonder how doctors and their patients are supposed to trust a medical literature that's permeated with bias . . . . I have no idea" (p. 112). When biases become shared among a whole community, it constitutes a dangerous *groupthink*, for example sustaining the belief that amyloid plaques are the cause of Alzheimer's

disease, against all the evidence that preventing or removing such plaques is entirely ineffective (p. 114). Political ideology is yet another possible source of bias.

The overall lesson, obvious but almost never learned, is that when statistical analysis is an integral part of research, independent professional statisticians ought to be consulted—*and their advice followed—in the initial planning of research protocols* as well as in the analysis of results (p. 209).

Chapter 5 deals with negligence. Some amusing and disheartening examples are given, and the common-sense point is made that published numbers should not obviously make no sense. It would always be useful to ask: How could such a conclusion come to be known? Was the sample large enough for adequate statistical power (p. 134)?

It is again disheartening to read that "large-scale reviews have . . . found under-powered research . . . [to be] rife in medical trials, biomedical research more generally, economics, brain imaging, nursing research, behavioral ecology, and . . . psychology" (p. 137). Claims to identify genes responsible for IQ scores, depression, schizophrenia, and a variety of other (usually behavioral) traits have almost invariably turned out to result from under-powered statistics (p. 141). It seems to have been forgotten that the founder of *p*-value statistics, Ronald Fisher, pointed out a century ago that "complex traits must be massively *polygenic* . . . related to many thousands of small-effect genes" (p. 142).

Institutions and individuals routinely exaggerate the import of claimed findings in order to gain public attention and funding. Chapter 6 describes several egregious instances of this hype, including the claimed discovery by NASA researchers of a life-form in which arsenic atoms replace phosphorus, something that seems impossible a priori; and indeed it was a mistaken claim. How very common hype has become is shown by a number of studies that found in scientific papers a striking increase since the 1970s in the use of such words as "innovative," "promising," "unique," "unprecedented." (Examining the frequency of word-usage in non-technical fields is facilitated by Google's "N-gram" application that searches a vast number of digitized books from as far back as when books were first printed.)

Hype, even when merely exaggeration rather than plainly false, risks causing damage to the credibility of scientists, scientific institutions, and science itself. Common instances include unwarranted advice, for example as to diet or exercise, and ballyhooing supposed medical advances on the basis of results only in cells in test tubes or in experimental animals. Just as with fraud and with innocent mistakes, the damage continues long after the scientific knowledge itself has been corrected, as the corrections are not hyped as emphatically as the initial claims had been. The detailed examples given in Chapter 6 deserve to be read by everyone. The most egregious hype is often associated with so-called emerging fields: stem cells, genetics, epigenetics, machine learning, brain imaging, the microbiome (the countless millions of microbes that infest our bodies) (pp. 160–161).

The book has a fine summary at the end of Chapter 6:

> even though caution, restraint and skepticism are basic virtues of science, we have a system that incentivizes the precise opposite. Scientists are pushed into publishing as many papers as possible, and hyping them up to the high heavens, by an academic system that's become an impediment to getting science right. (p. 172)

Part III of the book, "Causes and Cures," adds little to that summary. Chapter 7 spells out "Perverse Incentives" that have already been indicated throughout earlier chapters: Seeking prestige and wealth and careers, institutions and individuals both practice excessive publication and hype. A misdeed not mentioned earlier is the faking of peer review (p. 185 ff.) or of an individual's "h-index" (p. 187 f.), which was originally designed, like the "impact factor" (p. 190) for journals, to measure quality rather than quantity. Neither does what was hoped, as could have been foreseen under Goodhart's Law: "When a measure becomes the target, it ceases to be a good measure" (p. 192). It ought to be obvious that objective numerical measurements and calculations can never substitute for human judgment of *quality* or *value*.

I regret being unable to say anything good about Chapter 8, "Fixing Science." "The problems science faces are systemic, indicating an entire culture gone awry" (p. 190). Indeed. And that culture has gone awry not by itself but through the influence on it of the wider

society, in which wealth and power and influence and status are the desired outcomes, not at all what science supposedly seeks—the best achievable, most objective understanding of the material world. Science and scientists depend on the wider society for their resources, and the values and aims of that wider society thereby come to govern scientific activity. Trustworthy science depends on the honesty and integrity of researchers (p. 21), but that is not what contemporary society rewards. The fact that science publishing has become dominated by commercial businesses like Elsevier and Springer makes it whistling in the wind to suggest changes in publication practices toward making reliability and truthfulness the prime objectives.

Science is a human and social activity, as Ritchie pointed out early in the book. The overarching consequence is that there is really only one feasible way to cure contemporary dysfunctions: to remove the incentives that cause the regrettable behavior. But the present system of incentives is the same as in society at large: Success means to achieve status, influence, wealth, power. Researchers can become successful only by attaining what the wider society values. Ritchie himself recognizes that: "All we need to fix science is to give people the right motivation" (p. 234).

The book quite properly describes as desiderata the Mertonian Norms of "universalism," "communality," and "organized skepticism"; but these had been identified by sociologist Robert Merton around 1940, and had been reasonably achievable in practice only in the "good old days" when pure science was an ivory-tower activity largely independent of outside influences, a cottage industry of independent intellectual entrepreneurs, of comparatively little interest to the wider society and depending hardly at all on the wider society for needed resources; "pure" scientific research was then carried on with all or almost all the needed resources provided by the researchers' universities. World War II marked a sea change and a turning point (Bauer 2017, Chapter 1), as outside funding of research increased exponentially, culminating in the dysfunctional present state of affairs in which, as John Ziman (1994) pointed out, the Mertonian Norms had to be augmented with "originality," the incentive to produce something positively original, and where there is no longer any meaningful distinction between "pure" and "applied" research.

QUIBBLES AND CAVEATS

I recommend this book unreservedly. Its criticisms of contemporary scientific practices are appropriate, sound, superbly documented. It should be seen as a compliment to the book's meaty discussions that some quibbles and caveats and points of disagreement seem called for.

Although what Ritchie says does apply to science overall, there is a pervasive emphasis on statistical analysis, almost all of which is scarcely relevant to physical science, where replicability and proof and disproof are often much more straightforward. This bears noting because society's high regard for the trustworthiness of scientific facts, knowledge, and understanding rests primarily on the achievements of astronomy, physics, and chemistry, and it is important to realize that nothing like the certainty attainable in those can be matched by medical science or by the behavioral and social sciences where only knowledge of a probabilistic, statistical nature is attainable.

Regarding statistics, the Bayesian approach is given too short shrift. That the Bayesian prior is inherently subjective (p. 207 f.) doesn't matter; one can start with an arbitrary prior probability of 0.5, and as evidence accumulates the Bayesian method brings the calculated probability closer and closer to the objectively sustainable ("true") one. Matthews (1998, 1999) has explained why the Bayes method is even *in principle* preferable to the frequentist *p*-value approach.

Ritchie is spot-on in describing science as socially constructed in the sense that subjective interactions lead to less-subjective consensus; but Ritchie is not a postmodernist relativist constructionist of the former Edinburgh cult. But he might well have added that *time* is a crucial element in making science more reliable.

As to "in recent years it's become increasingly, painfully obvious that peer review is far from the guarantee of accuracy and reliability it's cracked up to be" (p. 15), actually that was obvious half a century ago to many practicing researchers; a wide-ranging discussion was published four decades ago (Peters & Ceci, 1982).

The lack of a separate bibliography is a minor inconvenience; the citations in the endnotes use a style common in the humanities, where once a reference has been cited in full it is subsequently repeated only by something like "Bauer, Dogmatism, pp. . . .", leaving a reader to search

earlier notes for full details of the source. It is not true, incidentally, that retracted articles always remain available on a journal's website (p. 66); it might be just the abstract or the original citation that remains (for example, Goodson, 2014).

That Andrew Wakefield's claims were fraudulent about autism and the MMR (measles mumps rubella) vaccine (pp. 76, 225) remains controversial (Canary Party, 2015). Such terms as "vaccine skeptic" (p. 78 ff.) or "anti-vaxxer" are pejorative and unwarranted; in most cases, "vaccine skeptics" are not opposed to *vaccination as such* but rather point to the unsatisfactory and often damaging so-called "side" effects of some vaccines, for example Cervarix and Gardasil against HPV (Holland et al., 2018).

The book is wrong in accepting the view that HIV is sexually transmitted (p. 239) and that HIV causes AIDS (p. 244); and in accepting the mainstream views on climate change (pp. 13, 34). Those last points drive home the danger warned against by President Eisenhower (1961): "in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific–technological elite."

It is instructive and also dismaying that so well-read and insightful an author as Stuart Ritchie has been misled in this way on topics where the mainstream consensus is clearly contradicted by profuse evidence in the professional literature (Bauer, 2012, pp. 18–29). Active researchers like Ritchie have no practical alternative to trusting what researchers in other fields conclude; and even someone so aware as Ritchie of the dysfunctions of contemporary science has not yet realized that public policies on important matters can be as badly mistaken nowadays as a century ago when accepted expert opinion about eugenics led to the forced sterilization of tens of thousands of Americans during about half of the 20th century.

Such public tragedies may be avoidable only if the scientific community learns to examine without preconception the possible merits of minority views, and if a truly impartial authority is established to provide governments, and also non-governmental institutions, with as objective and unbiased as possible an assessment of the relative merits of mainstream views and minority dissenting views—for instance a Science Court (Bauer, 2017, Chapter 12).

REFERENCES

Bauer, H. H. (2012). *Dogmatism in science and medicine: How dominant theories monopolize research and stifle the search for truth.* McFarland.

Bauer, H. H. (2017). *Science is not what you think: How it has changed, why we can't trust it, how it can be fixed.* McFarland.

Canary Party. (2015, October 1). *Timeline of events in the William Thompson CDC whistleblower scandal.* https://canaryparty.org/commentary/timeline-of-events-in-the-william-thompson-cdcwhistleblower-scandal

Eisenhower, D. D. (1961, January 17). Presidential farewell speech. *Public Papers of the Presidents, Dwight D. Eisenhower, 1960*, pp. 1035–1040. http://avalon.law.yale.edu/20th_century/eisenhower001.asp

Goodson, P. (2014, September 23). Questioning the HIV-AIDS hypothesis: 30 years of dissent. *Frontiers in Public Health, 2*, 154. https://doi.org/10.3389/fpubh.2014.00154. Retraction at https://www.frontiersin.org/articles/10.3389/fpubh.2014.00154/full

Holland, M., Rosenberg, K. M., & Iorio, E. (2018). *The HPV vaccine on trial: Seeking justice for a generation betrayed.* Skyhorse.

Matthews, R. A. J. (1998). Facts versus factions: The use and abuse of subjectivity in scientific research. *European Science and Environment Forum Working Paper*. https://hivskeptic.files.wordpress.com/2010/10/matthews.pdf
Also published in 2000 in J. Morris (Ed.), *Rethinking risk and the precautionary principle* (pp. 247–282), Butterworth-Heinemann.

Matthews, R. A. J. (1999). Significance levels for the assessment of anomalous phenomena. *Journal of Scientific Exploration, 13*(1), 1–7.

Peters, D. P., & Ceci, S. J. (1982). Peer-review practices of psychological journals: The fate of published articles, submitted again. *Behavioral and Brain Sciences, 5*(2), 187–195. https://doi.org/10.1017/S0140525X00011183

Ziman, J. (1994). *Prometheus bound: Science in a dynamic steady state.* Cambridge University Press.

Journal of Scientific Exploration, Vol. 35, No. 2, pp. 433–443, 2021 0892-3310/21

BOOK REVIEW

Mystery Cats of the World Revisited: Blue Tigers, King Cheetahs, Black Cougars, Spotted Lions, and More by Karl P. N. Shuker. Anomalist Books, 2020. 397 + xv pp. $24.95 (paperback). ISBN 978-1-949501-17-9.

Reviewed by George M. Eberhart

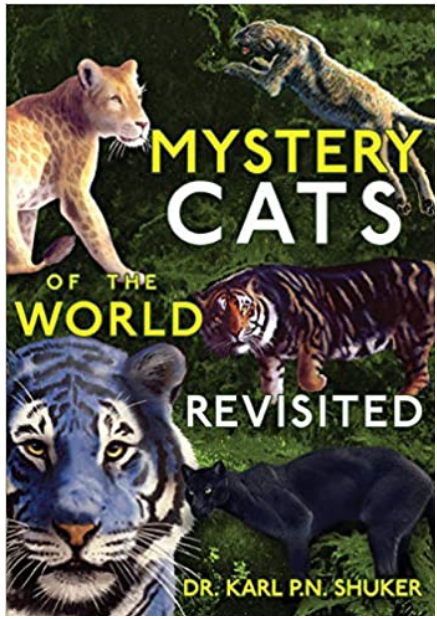
Chicago, Illinois

https://10.31275/20212011

At long last, after 31 years, the first book by noted British zoologist and cryptozoologist Karl Shuker has been expanded and updated. *Mystery Cats of the World* first appeared in 1989 and was the only book to review feline cryptids worldwide. In this 2020 edition, Shuker repeats this admirable achievement, and in the process gives us a solid overview of current knowledge of felid evolution, taxonomy, and genetic variation. In fact, the only feline mystery cat he does not describe is Hello Kitty. This edition will leave you purring with cryptozoological delight.

Shuker has more than kept up with cryptozoology over the years, keeping the public informed with numerous popular books on dragons, new and rediscovered animals, the Loch Ness monster, and many other lesser-known cryptids. His *ShukerNature* blog (2009 to present) and his regular "Alien Zoo" column in *Fortean Times* provide an always-fascinating glimpse into ongoing cryptozoological controversies.

Scientific names and genetic relationships are updated throughout the text in this new edition. He notes that since 1989, our understanding of genes that cause variations in felid coat color has become more complicated. For example, the chinchilla mutation in tyrosinase was then considered responsible for "partial albino" tigers (white tigers with black stripes). In 2020, a point mutation in a transporter protein that prevents the manufacture of pheomelanin (red and yellow pigments)



(Cover illustration by William Rebsamen)

is seen as a more likely cause. Rather than go into great detail about these ongoing discoveries, Shuker sensibly opts to include the bare minimum of updated felid genetics in his discussions of specific cryptids. However, for clarity and comparison he provides a table from the first edition that describes the six major genes and their mutant alleles that in the 1970s were thought by UK geneticist Roy Robinson (1978) to be responsible for major cat color morphs. (Believe me, this chart comes in handy throughout the book.)

With regard to current thinking on evolution, some authorities suspect modern felids are not necessarily descended from fossil nimravids (saber-tooth cats of the early Oligocene), as Shuker states, but Feliform taxonomy is in a constant state of flux. The next 20 years will undoubtedly see the emergence of new fossils and phylogenetic relationships.

Illustrations that appeared on glossy paper in the first edition have been moved into the text and reduced in size without, in most cases, any serious loss of resolution. This is an effective way to reduce costs, allow for many additional graphics, and reserve space for more content. The only serious case of unfortunate downsizing occurs on page 4, where a chart comparing dog and cat tracks has been minimized to a level requiring a magnifying glass.

The book is arranged into seven geographical chapters (and an eighth with conclusions and thoughts on cryptid conservation), followed by three appendices. In the following sections of this review, I will list the primary cryptids he describes to give a flavor of the diversity of animals included, with an emphasis on the updates to the first edition for comparison.

But first, I must mention one major bibliographic irritant. Shuker has taken the numbered endnotes from the first edition and transferred them to an unsorted, unalphabetized bibliography "in the order that they are first referenced" in each chapter, adding in new resources used in the current edition. The ostensible reason for this is given as "ease of direct cross-referencing between main text and bibliography." This is a tremendous disservice to the reader, who may not want to follow along in the bibliography to keep track of his place in the text. Granted, authors' names have been added in the text to make this slightly easier, but this just adds an unnecessary hurdle to fact-checking or follow-up. It would have been much more user-friendly to put the entries in alphabetical order by author, perhaps subdividing them by subtopics within each chapter.

The formatting of the index is a lesser annoyance, with page numbers wrapping flush left and interrupting a visual vertical scan of the entries, although this is the fault of the publisher, not the author.

GREAT BRITAIN

Shuker chooses to review primarily the same cases of British mystery pumas, lionesses, and lynxes that he focused on in the first edition, although numerous sightings (some with photos and video footage) have occurred since. The more recent cases do not really add much to the evidence, and in any case Shuker has described them in a chapter of his in-print book *Cats of Magic, Mythology, and Mystery* (2012). There is a new section on Isle of Wight mystery cats, and Shuker discusses the 1995 official UK government report on alleged mystery cats seen on Bodmin Moor in Cornwall (Baker & Wilson, 1995). The Ministry of Agriculture, Fisheries, and Food concluded that, though tracks found were from domestic cats and a dog, it could not disprove the presence of a much larger cat and that there seemed to be no significant threat to livestock.

Shuker has enhanced his multicausal solution for British big cats that he outlined in the first edition. In addition to sightings of domestic feral cats (*Felis catus*), Scottish wildcats (*F. silvestris silvestris*) outside their official range, escaped or released exotic cats (pumas, black leopards, and lions), and a handful of non-felids like dogs, he

now accepts the possibility of a lingering population of Eurasian lynxes (*Lynx lynx*), which supposedly died out in Britain 1,300 years ago. He finds no evidence for an unknown large felid species in the UK.

Since the first edition, the Kellas cat has been formally identified as a black-coated hybrid strain of Scottish wildcat and domestic cat. Shuker notes this and suggests that two black "rabbit-headed cats" shot in Scotland could be Kellas cats. He also speculates that these hybrids could have a long pedigree; Highland folklore about a black "fairy cat" (*cait sìth*) matches the description of a Kellas cat down to its white primary guard hairs.

IRELAND AND CONTINENTAL EUROPE

In this chapter, Shuker sorts through the myriad forms of European (*F. silvestris*) and African (*F. lybica*) wildcats, their recently simplified taxonomies, and how they might fit in with sightings of a Kellas-like black cat (*F. daemon*) reported in the South Caucasus and a now-forgotten small South African black cat (*F. obscura*) described in 1834. Still puzzling is the wildcat of Corsica (known locally as a "cat-fox"), first identified in 1929 and now considered a domestic cat variety introduced to the island in Roman times like its counterpart in Sardinia. But wildlife officials on Corsica analyzed fur from this felid in 2012 and found that its DNA was similar to an African wildcat.

Shuker also offers new information on the alleged Irish wildcat, including two 21st-century sightings and fossils of European wildcats in Ireland dating to as recently as 3,000 years ago. In addition, he records:

> Evidence that cave lions (*Panthera spelaea*) and scimitar cats (*Homotherium*) persisted into the late Pleistocene.
>
> A new report of a juvenile black panther (a melanistic leopard, *P. pardus*), undoubtedly a released pet, seen and captured in Armentières, Nord, France, in September 2019, then subsequently stolen from the pen where it was being held in the Maubeuge city zoo.
>
> A mention of the Beast of Gévaudan, France (Shuker, 2016), responsible for some 100 human deaths in the 1760s, which a new book by Karl-Hans Taake (2015) identifies as a juvenile lion (*P. leo*). However, Shuker favors the striped hyena (*Hyaena hyaena*) hypothesis, perhaps an import specially trained by notorious local

man Jean Chastel, in combination with predations by wolves (*Canis lupus*), as suggested by historian Jay M. Smith (2011) and other researchers.

ASIA

Unrecognized color variations seem to be a primary puzzlement for feline cryptids in Asia, although there may be a few undiscovered species as well. Shuker covers the genetic ins and outs of white, white stripeless, golden tabby, red, and brown stripeless color morphs of the tiger (*P. tigris*). He offers new information on the elusive blue tiger of South China, whose pelt may be due to a combination of double-recessive genes similar to those seen in the Maltese domestic cat. He provides extensive documentation on black tigers—both those with abnormally dark background coloration (melanistic) and those with abnormally widened black stripes (pseudo-melanistic)—and lays out new material on black tigers in ancient China and recent instances of pseudo-melanistic and partially black individuals killed in the wild or born in zoos.

Other Asian cat anomalies include:

A new single report of a tiger with a green background color in Vietnam.

Possible survival of the Bali and Javan tiger populations.

Updated taxonomy for the Iriomote cat of the Yaeyama islands of Japan, discovered in 1965 and now considered a subspecies of leopard cat (*Prionailurus bengalensis iriomotensis*).

A possible variety of clouded leopard (*Neofelis nebulosa*) on Iriomote island.

A few unrecognized leopard colorations.

Shuker also describes a clowder of mystery cats that are new to this edition, among them a blue-spotted cheetah (*Acinonyx jubatus*) kept by the Mughal Emperor Jahangir in 1608; a 16th-century painting of a striped king cheetah morph in India (described completely in an appendix that reprints his 2013 article on the topic in the *Journal of Cryptozoology*); the elusive *pogeyan* of the Western Ghats, India; a

supposed saber-tooth cat in China; the striped *seah malang poo* of Thailand; a short-tailed variant of the Asian golden cat (*Catopuma temminckii*) in Sumatra; and a horned cat from the Lesser Sunda Islands.

AFRICA

Africa seems to have a greater number of cat cryptids than any other continent. Shuker provides updated information on the king cheetah (cream-colored fur with blotchy spots and three dark stripes from neck to tail) of southern Africa. At one time it was thought to be a separate species, but since 2012 it has been recognized as a genetic mutation caused by reinforcement of a recessive allele. However, its multiple distinctions in pelage from normal cheetahs, as well as its forest habitat and nocturnal behavior, could mean (as Lena Bottriell suspects [1987]) that the king cheetah is in the process of becoming a new species through environmental adaptation. Shuker makes note of a possible king cheetah variety that once existed in Tanzania.

Shuker also lists some apparent cheetah genetic morphs, such as a small-spotted woolly variety in South Africa, a finely speckled version in Tanzania that he calls the "cheetaline," melanistic specimens, and a pale desert variety in the Qattara region of Egypt. All these are considered odd for a cat whose genetics are less varied than other species.

Shuker provides further information on the well-established spotted lion or *marozi* of the Aberdare Range in Kenya (and possibly other regions), known from pelts, observations, and indigenous lore. He favors a separate race or subspecies of lion. He also provides updated news on leucistic white lions observed in the wild and on game preserves; mostly photoshopped pictures of black lions; a supposed green lion from Uganda; rare melanistic African leopards (although these are common in Asia); and the *chakpuar* of Senegal, said to look like a lion with red fur and a long neck.

Also in this chapter we find further ruminations on the mysterious *mngwa* or *nunda* of Tanzania, a gray-striped, donkey-sized, purring felid allegedly responsible for human maulings in the 1930s. Shuker suggests as candidates an outsized African golden cat (*Caracal aurata*), a maneless buffalo lion akin to the famous Tsavo lions of 1898, or even violent young men dressed up as lions who thus attribute their murders to man-killing mystery cats.

Further felids:

Expanded evidence for existing or formerly existing striped cats (tigers) in south and east Africa.

Mountain tigers and water lions in central Africa with large teeth that, Shuker speculates following Bernard Heuvelmans (2007), could represent surviving machairodontid saber-tooth cats.

A new section on the *fitoaty*, a mysterious black wildcat of Madagascar that recent research suggests is taxonomically different from the island's known feral cats.

NORTH AMERICA

As the archetypal North American cat, the puma (*Puma concolor*) holds a central place among the continent's mystery cats. Eastern pumas are now no longer considered a subspecies, and in 2018 they were declared extinct, having been classified as endangered since 1973—even though alleged puma sightings in the Eastern states continue to be reported. Are they stragglers from the west or a breeding population?

Reports of black pumas, or other melanistic large cats, from 2012 to 2020 appear in an extensive appendix compiled from the *ShukerNature* blog. As with the British mystery cats, Shuker declines to mention recent sightings in the main part of the text because they are so similar to reports documented in the first edition. He once again lists the major candidates for black panther sightings—the cat-like fisher (*Pekania penannti*), black feral domestic cats, the jaguarundi (*Herpailurus* or *Puma yagouaroundi*), a melanistic bobcat (*Lynx rufus*), melanistic pumas (including some recent specimens), melanistic leopards, or melanistic jaguars (*P. onca*). He suspects the explanation for black pumas is multicausal but involves melanism in several species, as proposed by Mark Mayes (2018), especially for reports in Texas and the South.

Shuker next examines recent reports of maned mystery lions in the U.S. and suggests three explanations: large dogs, African lion escapees or releases, and possibly a surviving fossil American lion (*P. atrox*), as advocated by Loren Coleman (1980). However, he points out that morphological and behavioral attributes make the latter hypothesis somewhat untenable.

Other cryptids include a single new report from Tennessee in 1996 of a cheetah-like cat with a red head and paws, a red dorsal stripe from its head to its tail, and a golden-brown body with black stripes and spots; some improbable rumors of a living saber-tooth cat (*Smilodon fatalis*) in the American Southwest; North Carolina's mystery felid, the "Santer," from the 1890s; and a folkloric assortment of unlikely feline wowzers, wampus cats, glawackuses, splinter cats, cactus cats, and Ozark howlers.

MEXICO, CENTRAL, AND SOUTH AMERICA

Shuker provides an update on the *onza,* a puma-like felid with long limbs and a slender body from Mexico's Sierra Madre Occidental range, for which there is some physical evidence in the form of skulls, pelts, and one complete specimen. The latter turned out to be a genuine puma, although the results of this analysis had not been released when this book's first edition was published. Shuker writes that this does not negate the possibility of a real *onza* living in the wild, which could represent a puma color morph, a puma subspecies, or a completely new species, such as a surviving American cheetah (*Miracinonyx trumani*).

Other Central American cat cryptids include the Aztec "wolf-cat" reportedly seen in Moctezuma II's zoo; Christopher Columbus's fearsome ape-faced cat; and the Nayarit ruffed cat, two pelts of which zoologist Ivan T. Sanderson (1973) once obtained and which apparently is represented in Aztec and Mayan carvings.

South American mystery cats include several unrecognized jaguar varieties (albino or leucistic "ghost" jaguars) and the *jaguarete* (dark on top with white underparts), which Shuker suggests could be a black-and-tan or pseudo-melanistic jaguar morph or even a rare melanistic puma.

New cryptids in this edition are the *yana puma,* an entirely black puma morph of great size found in the Peruvian highlands; the *onça-canguçú,* a black jaguar with a white collar and a tufted leonine tail tip; a large gray jaguar with solid black speckles; a brown "rock jaguar"; and a red jaguar known from only one account in Brazil.

Shuker provides updates on a wide assortment of miscellaneous felids:

Siemel's mystery cat in Brazil's Mato Grosso, which seems to be a puma with brown spots and a dark stripe across its spine, possibly a puma x leopard hybrid.

The *warracaba* of Guyana, a jaguar that hunts in packs.

The dog-like *mitla* of Bolivia.

Various pack-hunting mystery cats of Peru, Venezuela, and Ecuador.

A white-coated cat with solid black spots from Ecuador.

A tapir-hunting, semi-aquatic, dark-gray cat with massive paws.

A black rainbow tiger with multicolored stripes on its chest.

A striped tiger in Peru, Colombia, and Ecuador, as well as a Venezuelan cat known as the *wairarima*, any of which could represent a surviving saber-tooth (*Smilodon*).

A handful of puma-sized, shaggy-haired, amphibious "water tigers" variously known as *iemisch*, *yaquaru*, *entzaeia-yawá*, *maipolina*, or *chongonga*. Shuker considers the possibility these could represent a saber-tooth adapted to aquatic life, perhaps analogous to the water lions of Africa.

AUSTRALASIA

Shuker offers little new information on the Queensland marsupial tiger except to refer to new books by Tony Healy and Paul Cropper (1994), and Malcolm Smith (1996), and his own updated 2016 volume. After considering whether the tiger could be a surviving dog-like thylacine (*Thylacinus cynocephalus*) and reviewing the status of its persistence on the mainland, Shuker turns to his favored explanation, a surviving form of the marsupial lion (*Thylacoleo*), whose fossils are found throughout the continent.

Tawny-colored pumas and black panthers continue to be seen in Western Australia, New South Wales, and Victoria. Among Shuker's candidates to explain these sightings are a novel strain of giant black feral domestic cat for which there is some recent evidence, and one tantalizing report from 1961 involving a black panther with a pouched cub, suggesting a marsupial classification. He has also found that some scientific laboratories might be deliberately misidentifying cat fur and scat as canine, further muddying the trail of evidence.

New in this edition is a section on the shaggy-maned mystery lion of the Blue Mountains known to local Aboriginal Australians as the *warragal.* Shuker agrees with cryptozoologist Rex Gilroy (2006) that it could represent another form of *Thylacoleo* species differing in character from the Queensland tiger.

A new section on New Guinea mystery cats includes one recent sighting of a striped cat, and a final section reviews the rare, if real, mystery cats of New Zealand and Hawaii.

SUMMARY

Shuker sums it all up in a final chapter in which he concludes there are three types of modern-day mystery cats: species unknown to science; unrecorded morphs or non-taxonomic forms of known species; and known species occurring in unexpected localities.

In a plea to fellow researchers, Shuker looks toward the future of this specialized form of natural history:

> It is time for cryptozoology to come of age. It continues to gain interest and respect, but it must now accept a major responsibility too. No longer should it be content merely to seek out new animals, it must also ensure that its discoveries are conserved and perpetuated, otherwise its goals will be meaningless, its ideals empty.

Finally, he quotes the late cryptozoologist Lionel Beer, who advised: "Take only memories, leave only footprints, kill only time."

REFERENCES

Baker, S. J., & Wilson, C. J. (1995). *The evidence for the presence of large exotic cats in the Bodmin area and their possible impact on livestock.* UK Ministry of Agriculture, Fisheries, and Food.

Bottriell, L. G. (1987). *King cheetah: The story of the quest.* E. J. Brill.

Coleman, L. (1980, Spring). On the trail: Maned mystery cats. *Fortean Times, 31,* 24–27.

Gilroy, R., & Gilroy, H. (2006). *Out of the dreamtime: The search for Australasia's unknown animals.* URU Publications.

Healy, T., & Cropper, P. (1994). *Out of the shadows: Mystery animals of Australia.* Pan Macmillan Australia.

Heuvelmans, B. (2007). *Les félins encore inconnus d'Afrique.* L'Oeil du Sphinx.

Mayes, M. (2018). *Shadow cats: The black panthers of North America.* Anomalist Books.

Robinson, R. (1978, January). Homologous coat color variation in *Felis. Carnivore, 1*, 68–71.

Sanderson, I. T. (1973, April). More new cats? *Pursuit, 6*, 35–36.

Shuker, K. P. N. (1989). *Mystery cats of the world: From blue tigers to Exmoor beasts.* Robert Hale.

Shuker, K. P. N. (2009–). *ShukerNature* [blog]. karlshuker.blogspot.com

Shuker, K. P. N. (2012). *Cats of magic, mythology, and mystery: a feline phantasmagoria.* CFZ Press.

Shuker, K. P. N. (2015, August 22). The Beast of Gévaudan—Wolf, man . . . or wolf-man? *ShukerNature.* karlshuker.blogspot.com/2015/08/the-beast-of-gevaudan-wolf-manor-wolf.html

Shuker, K. P. N. (2016). *Still in search of prehistoric survivors: The creatures that time forgot?* Coachwhip Publications.

Smith, J. M. (2011). *Monsters of the Gévaudan: The making of a beast.* Harvard University Press.

Smith, M. (1996). *Bunyips and bigfoots: In search of Australia's mystery animals.* Millennium.

Taake, K.-H. (2015). *The Gévaudan tragedy: The disastrous campaign of a deported "beast."* Kindle.

SSE ASPIRING EXPLORERS PROGRAM

The SSE has established Aspiring Explorers Awards for meritorious student research projects judged to be the most original and well-executed submissions in subject areas of interest to the SSE. A committee is in place to review all entries and determine the winners, who will receive awards of $500 each. One award winner will have the opportunity to present a talk describing the project at the SSE Annual Meeting, for which the Society will cover their registration fee. The other award winner will have the opportunity to present a talk describing their project at the SSE Euro Meeting, for which the Society will cover their registration fee. Submissions must be made per the guidelines and deadline as stated on the SSE website "Call for Papers" for the conference you are considering attending in order to be eligible for that year's prize for that conference.

If your paper is selected for the Aspiring Explorer Award, you will be either invited to present your talk at the meeting or able to submit your paper as a poster session. We are very excited about the recent poster sessions at annual SSE meeting, so please let your fellow student colleagues and professors know about this possibility for the 2022 conference.

In addition, the SSE is also offering a 50% discount on future meeting registrations for any student member who brings one student friend to our conferences (one discount per student). We are eager to see student clubs or SSE discussion groups established at various academic institutions or in local communities. Contact us at education@scientificexploration.org to start your own group!

C. M. Chantal Toporow, Ph.D., SSE Education Officer
education@scientificexploration.org

Society for Scientific Exploration

Executive Committee

Council

Appointed Officers

Bial AWARD

IN BIOMEDICINE 2021

BIAL Award in Biomedicine 2021 - €300.000

Seeks to recognize a work published in the broad biomedical field after 1 January 2012, the results of which are considered of exceptional quality and scientific relevance.

Only works nominated by the voting members of the Jury, by the members of the Scientific Board of the BIAL Foundation, by previous BIAL award winners or by Scientific Societies may be considered candidates. The Jury may also invite other scientific institutions to submit nominations. Self-nominations are not allowed.

Jury

President
Ralph Adolphs

Members

European Research Council
Geneviève Almouzni
Paola Bovolenta

Council of Rectors of Portuguese Universities
Maria do Carmo Fonseca
Fátima Carneiro

European Medical Association
Vincenzo Costigliola
Olga Golubnitschaja

Scientific Board of the BIAL Foundation
Hugo Critchley
Menno Witter

Previous winners of the BIAL Award
Peter St. George-Hyslop
Daniel Pipeleers

Scientific Journals
Howard Bauchner - JAMA
Eric Rubin - NEJM

Nomination form must be sent by 30 June 2021 to
fundacao@bial.com

Regulation and nomination form available at
www.fundacaobial.com

FUNDAÇÃO Bial
Institution of public utility

COM O ALTO PATROCÍNIO DE SUA EXCELÊNCIA O Presidente da República
UNDER THE HIGH PATRONAGE OF THE PRESIDENT OF THE PORTUGUESE REPUBLIC

CRUP CONSELHO DE REITORES DAS UNIVERSIDADES PORTUGUESAS

EMA European Medical Association

Dear Colleague,

The BIAL Foundation is soliciting nominations for its 2021 Award in Biomedicine. The Award recognizes a single paper of empirical biomedical research of outstanding scientific quality published in a peer-reviewed journal since 2012. The Award consists of a prize of 300,000 Euro and proposals must be submitted by 30 June 2021. The following persons and institutions are invited to make submissions:

- Ø voting members of the Jury;
- Ø members of the Scientific Board of the BIAL Foundation;
- Ø previous BIAL award winners;
- Ø Scientific Societies in the biomedical field;
- Ø Boards or Deans of Medical Faculties;
- Ø Heads of leading research institutes in the biomedical field;
- Ø Boards or Heads of prestigious Academies;
- Ø in addition, highly qualified researchers may nominate candidate works, but self-nominations are not accepted.

A maximum of two nominations can be submitted by an organized group of scientists, such as a university, society, academy, or research institute. The nominating panel should not include individuals who contributed to the nominated work. Nominations are welcomed for works authored by scientists at any stage of their career, and from any country around the world.

If you know of a work in the field of biomedical research, published in the last 10 years deserving being submitted, don't delay in taking a look at the BIAL Foundation website for further information about the submission procedure.

Thank you very much in advance for your help and kind regards,

Ralph Adolphs, Bren Professor of Psychology, Neuroscience, and Biology, Caltech
President of the Jury, BIAL AWARD IN BIOMEDICINE 2021
T +351 229 866 150; fundacao@bial.com

About the BIAL Foundation: The Bial Foundation was established in 1994 by BIAL and the Council of Rectors of Portuguese Universities. BIAL Foundation's mission is to foster the scientific study of the human being from both the physical and spiritual perspectives. It is managed by representatives from both institutions. Among its activities, the Foundation manages scientific Awards – BIAL Award in Biomedicine, Prémio BIAL de Medicina Clínica and Maria de Sousa Award – promoting the research in medical and biomedical areas. The BIAL Foundation also supports scientific research projects for the neurophysiological and mental study of the human being, arousing the interest of researchers in the areas of Psychophysiology and Parapsychology. Furthermore, biannually the Foundation organizes the Symposium "Behind and Beyond the Brain". More information is available from the Foundation's website at www.fundacaobial.com

About the BIAL Award in Biomedicine 2021: The BIAL Award in Biomedicine was created in 2018 to extend the scope of the BIAL Foundation's activity and to acknowledge the most notable and relevant discoveries in the field of biomedicine. This award, with a prize of €300,000, aims to recognise high quality, scientifically relevant research in the biomedical field published as of 1 January 2012. The Award is granted bi-annually since 2019. Only works nominated by the Voting members of the Jury, the members of the Scientific Board of the BIAL Foundation, previous BIAL award winners and Scientific Societies may be considered candidates. The Jury may also invite other scientific institutions to submit proposals, but self-nominations are not accepted. The BIAL Award in Biomedicine has the support of the President of the Portuguese Republic, the Council of Rectors of Portuguese Universities and the European Medical Association.

Index of Previous Articles in the Journal of Scientific Exploration

Vol: No.	Article	Author(s)
1:1	A Brief History of the Society for Scientific Exploration	P. Sturrock
	Alterations in Recollection of Unusual and Unexpected Events	D. Hall et al.
	Toward a Quantitative Theory of Intellectual Discovery (Esp. in Phys.)	R. Fowler
	Engineering Anomalies Research	R. Jahn et al.
	Common Knowledge about the Loch Ness Monster	H. Bauer
	An Analysis of the Condon Report on the Colorado UFO Project	P. Sturrock
1:2	The Strange Properties of Psychokinesis	H. Schmidt
	What Do We Mean by "Scientific?"	H. Bauer
	Analysis of a UFO Photograph	R. Haines
	Periodically Flashing Lights Filmed off the Coast of New Zealand	B. Maccabee
2:1	Commonalities in Arguments over Anomalies	H. Bauer
	Remote Viewing and Computer Communications—An Experiment	J. Vallee
	Is There a Mars Effect?	M. Gauquelin
	Raising the Hurdle for the Athletes' Mars Effect	S. Ertel
2:2	UFOs and NASA	R. Henry
	The Nature of Time	Y. Terzian
	Operator-Related Anomalies in a Random Mechanical Cascade	B. Dunne et al.
	Evidence for a Short-Period Internal Clock in Humans	T. Slanger
	Three New Cases of Reincarnation Types in Sri Lanka with Written Records	I. Stevenson et al.
3:1	Arguments Over Anomalies: H. \?Polemics	H. Bauer
	Anomalies: Analysis and Aesthetics	R. Jahn
	Trends in the Study of Out-of-Body Experiences	C. Alvarado
	A Methodology for the Objective Study of Transpersonal Imagery	W. Braud/ M. Schlitz
	The Influence of Intention on Random and Pseudorandom Events	D. Radin/J. Utts
	Case of Possession Type in India with Evidence of Paranormal Knowledge	I. Stevenson et al.
3:2	New Ideas in Science	T. Gold
	Photo Analysis of an Aerial Disc Over Costa Rica	R. Haines/J. Vallee
	Three Cases of Children in Northern India Who Remember a Previous Life	A. Mills
	"Signatures" in Anomalous Human–Machine Interaction Data	D. Radin
	A Case of Severe Birth Defects Possibly Due to Cursing	I. Stevenson
4:1	Biochemical Traumatology/Plant Metabolic Disorders in a UFO Landing	M. Bounias
	Return to Trans-en-Provence	J. Vallee
	Analysis of Anomalous Physical Traces: 1981 Trans-en-Provence UFO Case	J. Velasco
	Physical Interpretation of Very Small Concentrations	H. Bauer
	Luminous Phenomena and Seismic Energy in the Central United States	J. Derr/ M. Persinger
	Photo Analysis of an Aerial Disc Over Costa Rica: New Evidence	R. Haines/J. Vallee
	A Scientific Inquiry into the Validity of Astrology	J. McGrew/R. McFall
	Planetary Influences on Human Behavior: Absurd for a Scientific Explanation?	A. Müller
	Five Arguments against Extraterrestrial Origin of Unidentified Flying Objects	J. Vallee
4:2	Using the Study of Anomalies To Enhance Critical Thinking in the Classroom	M. Swords
	Observations of Electromagnetic Signals Prior to California Earthquakes	M. Adams
	Bayesian Analysis of Random Event Generator Data	W. Jefferys
	Moslem Case of Reincarnation Type in Northern India: Analysis of 26 Cases	A. Mills
	Electromagnetic Disturbances Associated with Earthquakes	M. Parrot

Extrasensory Interactions between Homo Sapiens and Microbes — C. Pleass/N. Dey
Correlation between Mental Processes and External Random Events — H. Schmidt
Phobias in Children Who Claim To Remember Previous Lives — I. Stevenson
A Gas Discharge Device for Investigating Focused Human Attention — W. Tiller
Radio Emissions from an Earthquake — J. Warwick

5:1 The Cydonian Hypothesis — J. Brandenburg et al.
Cases in Burma, Thailand, and Turkey: Aspects of I. Stevenson's Research — J. Keil
Effects of Consciousness on the Fall of Dice: A Meta-Analysis — D. Radin/D. Ferrari
The Wasgo or Sisiutl: A Cryptozoological Sea-Animal — M. Swords
The Extraterrestrial Hypothesis Is Not That Bad — R. Wood
Toward a Second-Degree Extraterrestrial Theory of UFOs — J. Vallee
Low-Frequency Emissions: Earthquakes and Volcanic Eruptions in Japan — T. Yoshino

5:2 Eccles's Model of Mind–Brain Interaction and Psychokinesis — W. Giroldini
Ball Lightning and St. Elmo's Fire as Forms of Thunderstorm Activity — A. Grigor'ev et al.
Social Scientific Paradigms for Investigating Anomalous Experience — J. McClenon
Count Population Profiles in Engineering Anomalies Experiments — R. Jahn et al.
Children Claiming Past-Life Memories: Four Cases in Sri Lanka — E. Haraldsson

6:1 Can the UFO Extraterrestrial Hypothesis and Vallee Hypotheses Be Reconciled? — W. Bramley
Learning for Discovery: Establishing the Foundations — R. Domaingue
On the Bayesian Analysis of REG Data (Response from W. Jefferys) — Y. Dobyns
Electrodynamic Activities and Their Role in the Organization of Body Pattern — M. W. Ho et al.

6:2 Review of Approaches to the Study of Spontaneous Psi Experiences — R. White
Survival or Super-Psi?: Interchange Responses — I. Stevenson/S. Braude
The Psychokinesis Effect: Geomagnetic Influence, Age and Sex Differences — L. Gissurarson
Are Reincarnation Type Cases Shaped by Parental Guidance? — S. Pasricha

6:3 Heim's Theory of Elementary Particle Structures — T. Auerbach
Better Blood through Chemistry: A Laboratory Replication of a Miracle — M. Epstein
The Gauquelin Effect Explained? Comments on Müller's Planetary Correlations — S. Ertel
The Gauquelin Effect Explained? A Rejoinder to Ertel's Critique — A. Müller
Ball Lightning Penetration into Closed Rooms: 43 Eyewitness Accounts — A. Grivor'ev et al.
A Series of Possibly Paranormal Recurrent Dreams — I. Stevenson

6:4 Experiments in Remote Human/Machine Interaction — B. Dunne et al.
A Low Light Level Diffraction Experiment for Anomalies Research — S. Jeffers et al.
A New Look at Maternal Impressions: An Analysis of 50 Published Cases — I. Stevenson
Alternative Healing Therapy on Regeneration Rate of Salamander Forelimbs — D. Wirth et al.

7:1 Accultured Topographical Effects of Shamanic Trance Consciousness — P. Devereux
Mainstream Sciences vs. Parasciences: Toward an Old Dualism? — G. L. Eberlein
Existence of Life and Homeostasis in an Atmospheric Environment — S. Moriyama
A Guide to UFO Research — M. D. Swords

7:2 Non-Causality as the Earmark of Psi — H. Schmidt
Adequate Epistemology for Scientific Exploration of Consciousness — W. W. Harman
Puzzling Eminence Effects Might Make Good Sense — S. Ertel
Comments on Puzzling Eminence Effects — J. W. Nienhuys
A Systematic Survey of Near-Death Experiences in South India — S. Pasricha
The Willamette Pass Oregon UFO Photo Revisited: An Explanation — I. Wieder

7:3 Near Death Experiences: Evidence for Life After Death? — M. Schröter-Kunhardt
Analysis of the May 18, 1992, UFO Sighting in Gulf Breeze, Florida — B. Maccabee
Selection Versus Influence in Remote REG Anomalies — Y. Dobyns

Dutch Investigation of the Gauquelin Mars Effect — J. Nienhuys
Comments on Dutch Investigations of the Gauquelin Mars Effect — S. Ertel
What Are Subtle Energies? — W. Tiller

7:4 Explaining the Mysterious Sounds Produced by Very Large Meteor Fireballs — C. S. L. Keay
Neural Network Analyses of Consciousness-Related Patterns — D. I. Radin
Applied Parapsychology: Studies of Psychics and Healers — S. A. Schouten
Birthmarks and Birth Defects Corresponding to Wounds on Deceased Persons — I. Stevenson
The "Enemies" of Parapsychology — R. McConnell

8:1 Survey of the American Astronomical Society Concerning UFOs: Part 1 — P. Sturrock
Anatomy of a Hoax: The Philadelphia Experiment Fifty Years Later — J. Vallee
Healing and the Mind: Is There a Dark Side? — L. Dossey
Alleged Experiences Inside UFOs: An Analysis of Abduction Reports — V. Ballester Olmos
What I See When I Close My Eyes — R. Targ

8:2 Survey of the American Astronomical Society Concerning UFOs: Part 2 — P. Sturrock
Series Position Effects in Random Event Generator Experiments — B. Dunne et al.
Re-Examination of the Law of Conservation of Mass in Chemical Reactions — K. Volkamer et al.
The 'Genius Hypothesis': Exploratory Concepts for Creativity — E. Laszlo

8:3 Survey of the American Astronomical Society Concerning UFOs: Part 3 — P. Sturrock
Strong Magnetic Field Detected Following a Sighting of an UFO — B. Maccabee
Complementary Healing Therapy for Patients with Type I Diabetes Mellitus — D. P. Wirth
Report of an Indian Swami Claiming to Materialize Objects — E. Haraldsson

8:4 Scientific Analysis of Four Photos of a Flying Disk Near Lac Chauvet, France — Pierre Guérin
A Linear Pendulum Experiment: Operator Intention on Damping Rate — R. D. Nelson
Applied Scientific Inference — P. A. Sturrock
The Mind-Brain Problem — J. Beloff

9:1 Unconventional Water Detection: Field Test of Dowsing in Dry Zones: Part 1 — H. Betz
Digital Video Analysis of Anomalous Space Objects — M. Carlotto
The Critical Role of Analytical Science in the Study of Anomalies — M. Epstein
Near-Death Experiences in South India: A Systematic Survey — S. Pasricha
Human Consciousness Influence on Water Structure — L. Pyatnitsky/V. Fonkin

9:2 Unconventional Water Detection: Field Test of Dowsing in Dry Zones: Part 2 — H. Betz
Semi-molten Meteoric Iron Associated with a Crop Formation — W. Levengood/MJ. Burke
Experiments on a Possible g-Ray Emission Caused by a Chemical Process — V. Noninski et al.
The Effect of Paranormal Healing on Tumor Growth — F. Snel/P. van der Sijde
Psychokinetic Action of Young Chicks on the Path of an Illuminated Source — R. Peoc'h
Eddington's Thinking on the Relation between Science and Religion — A. Batten
Two Kinds of Knowledge: Maps and Stories — H. Bauer

9:3 Experiments on Claimed Beta Particle Emission Decay — V. Noninski et al.
Assessing Commonalities in Randomly Paired Individuals — T. Rowe et al.
Anomalously Large Body Voltage Surges on Exceptional Subjects — W. Tiller et al.
Six Modern Apparitional Experiences — I. Stevenson
Viewing the Future: A Pilot Study with an Error-Detecting Protocol — R. Targ et al.
Could Extraterrestrial Intelligences Be Expected to Breathe Our Air? — M. Swords

9:4 Decision Augmentation Theory: Applications to Random Number Generators — E. May
Extrasensory Perception of Subatomic Particles & Referee Interchange (Dobyns) — S. Phillips
North American Indian Effigy Mounds — A. Apostol
A Holistic Aesthetic for Science — B. Kirchoff

10:1	An Assessment of the Evidence for Psychic Functioning	J. Utts
	Evaluation of a Program on Anomalous Mental Phenomena	R. Hyman
	CIA-Initiated Remote Viewing Program at Stanford Research Institute	H. Puthoff
	Remote Viewing at Stanford Research Institute in the 1970s: A Memoir	R. Targ
	American Institutes for Research Review of the STAR GATE Program	E. May
	FieldREG Anomalies in Group Situations	R. Nelson et al.
	Anomalous Organization of Random Events by Group Consciousness	D. Radin et al.
10:2	Critical Review of the "Cold Fusion" Effect	E. Storms
	Do Nuclear Reactions Take Place Under Chemical Stimulation?	J. Bockris et al.
	Claimed Transmutation of Elements Caused by a Chemical Process	V. Noninski et al.
	Selection versus Influence Revisited: New Methods and Conclusions	Y. Dobyns
	Illegitimate Science? A Personal Story	B. Maccabee
	Anomalous Phenomena Observed in the Presence of a Brazilian "Sensitive"	S. Krippner et al.
10:3	Mass Modification Experiment Definition Study	R. Forward
	Atmospheric Mass Loss on Mars and the Consequences	H. Lammer
	Exploring Correlations between Local Emotional and Global Emotional Events	D. Bierman
	Archetypes, Neurognosis and the Quantum Sea	C. Laughlin
10:4	Distance Healing of Patients with Major Depression	B. Greyson
	Cases of the Reincarnation Type: Evaluation of Some Indirect Evidence	J. Keil
	Enhanced Congruence between Dreams and Distant Target Material	S. Krippner et al.
	Recent Responses to Survival Research (Responses by Braude & Wheatley)	R. Almeder
	Toward a Philosophy of Science in Women's Health Research	A. Lettieri
11:1	Biased Data Selection in Mars Effect Research	S. Ertel/K. Irving
	Is the "Mars Effect" Genuine?	P. Kurtz et al.
	Fortean Phenomena on Film: Evidence or Artifact?	R. Lange/J. Houran
	Wishing for Good Weather: A Natural Experiment in Group Consciousness	R. Nelson
	Empirical Evidence for a Non-Classical Experimenter Effect	H. Walach/S. Schmidt
	Consciousness, Causality, and Quantum Physics	D. Pratt
11:2	Anomalous Cognition Experiments and Local Sidereal Time	S. J. P. Spottiswoode
	Evidence that Objects on Mars are Artificial in Origin	M. Carlotto
	The Astrology of Time Twins: A Re-Analysis & Referee Interchange (Roberts)	C. French et al.
	Unconscious Perception of Future Emotions: An Experiment in Presentiment	D. Radin
	A Bayesian Maximum-Entropy Approach to Hypothesis Testing	P. Sturrock
	Planetary Diameters in the Surya-Siddhanta	R. Thompson
	Science of the Subjective	R. Jahn/B. Dunne
11:3	Accessing Anomalous States of Consciousness with Binaural Beat Technology	F. Holmes Atwater
	The "Mars Effect" As Seen by the Committee PARA	J. Dommanget
	Astrology and Sociability: A Comparative Psychological Analysis	S. Fuzeau-Braesch
	Comparison between Children with and without Previous-Life Memories	E. Haraldsson
	Did Life Originate in Space? Discussion of Implications of Recent Research	A. Mugan
	Correlations of Random Binary Sequences with Pre-Stated Operator Intention	R. Jahn et al.
	The Hidden Side of Wolfgange Pauli: An Encounter with Depth Psychology	H. Atmanspacher/ Primas
11:4	Topographic Brain Mapping of UFO Experiencers	N. Don/G. Moura
	Toward a Model Relating Empathy, Charisma, and Telepathy	J. Donovan
	The Zero-Point Field and the NASA Challenge of Create the Space Drive	B. Haisch/A. Rueda
	Motivation and Meaningful Coincidence: Further Examination of Synchronicity	T. Rowe et al.
	A Critique of Arguments Offered against Reincarnation	R. Almeder
	The Archaeology of Consciousness	P. Devereux

12:1 Gender Differences in Human/Machine Anomalies — B. Dunne
Statement Validity Analysis of "Jim Ragsdale Story": Roswell Implications — J. Houran/S. Porter
Experiment Effects in Scientifi c Research: How Widely Are They Neglected? — R. Sheldrake
Roswell—Anatomy of a Myth — K. Jeffery
A Different View of "Roswell—Anatomy of a Myth" — M. Swords
Critique of "Roswell—Anatomy of a Myth" — R. Woods

12:2 Physical Evidence Related to UFO Reports — P. A. Sturrock et al.
Empirical Evidence Against Decision Augmentation Theory — Y. Dobyns/R. Nelson
Cases of Reincarnation in Northern India with Birthmarks and Birth Defects — S. Pasricha
Can the Vacuum Be Engineered for Spaceflight Applications? Overview. — H. E. Puthoff
Four Paradoxes Involving the Second Law of Thermodynamics — D. Sheehan
The Paranormal Is Not Excluded from Physics — O. Costa de Beauregard

12:3 Estimates of Optical Power Output in Six Cases of Unexplained Aerial Objects — J. Vallee
Analyses in Ten Cases of Unexplained Aerial Objects with Material Samples — J. Vallee
Do Near-Death Experiences Provide Evidence for Survival of Human Personality — E. Cook et al.
Anomalous Statistical Influence Depends on Details of Random Process — M. Ibison
FieldREG II: Consciousness Field Effects: Replications and Explorations — R. D. Nelson et al.
Biological Effects of Very Low Frequency (VLF) Atmospherics in Humans — A. Schienle et al.

12:4 The Timing of Conscious Experience: Causality-Violating — F. A. Wolf
Double-Slit Diffraction Experiment of Investigate Consciousness Anomalies — M. Ibison/S. Jeffers
Techno-Dowsing: A Physiological Response System to Improve Psi Training — P. Stevens
Physical Measurement of Episodes of Focused Group Energy — W. Rowe
Experimental Studies of Telepathic Group Communication of Emotions — J. Dalkvist/Westerlund
Strategies for Dissenting Scientists — B. Martin

13:1 Significance Levels for the Assessment of Anomalous Phenomena — R. A. J. Matthews
Retrotransposons as Engines of Human Bodily Transformation — C. A. Kelleher
A Rescaled Range Analysis of Random Events — F. Pallikari/E. Boller
Subtle Domain Connections to the Physical Domain Aspect of Reality — W. A. Tiller
Parapsychology in Intelligence: A Personal Review and Conclusions — K. A. Kress
Dreaming Consciousness: More Than a Bit Player in the Mind/Body Problem — M. Ullman

13:2 The Effect of "Healing with Intent" on Pepsin Enzyme Activity — T. Bunnell
Electronic Device-Mediated pH Changes in Water — W. Dibble/W. Tiller
Variations on the Foundations of Dirac's Quantum Physics — J. Edmonds
Do Cases of the Reincarnation Type Show Similar Features over Many Years? — J. Keil/I. Stevenson
Optical Power Output of an Unidentifi ed High Altitude Light Source — B. Maccabee
Registration of Actual and Intended Eye Gaze: Correlation with Spiritual Beliefs — G. Schwartz/L. Russek
Real Communication? Report on a SORRAT Letter-Writing Experiment — I. Grattan-Guinness
What are the Irreducible Components of the Scientific Enterprise? — I. Stevenson
Anomalies in the History of Relativity — I. McCausland
Magic of Signs: A Nonlocal Interpretation of Homeopathy — H. Walach

13:3 Second Sight and Family History: Pedigree and Segregation Analyses — S. Cohn
Mound Configurations on the Martian Cydonia Plain — H. Crater/S. McDaniel
Geomorphology of Selected Massifs on the Plains of Cydonia, Mars — D. Pieri
Atmosphere or UFO? A Response to the 1997 SSE Review Panel Report — B. Maccabee
An Unusual Case of Stigmatization — M. Margnelli
Methuselah: Oldest Myth. or Oldest Man? — L. McKague

Analysis of Technically Inventive Dream-Like Mental Imagery — B. Towe/Randall-May
Exploring the Limits of Direct Mental Influence: Two Studies — C. Watt et al.

13:4 Experimental Systems in Mind–Matter Research — R. Morris
Basic Elements and Problems of Probability Theory — H. Primas
The Significance of Statistics in Mind–Matter Research — R. Utts
Introductory Remarks on Large Deviations Statistics — Amann/Atmanspacher
p-adic Information Spaces. Small Probabilities and Anomalous Phenomena — A. Khrennikov
Towards an Understanding of the Nature of Racial Prejudice — Hoyle/Wickramasinghe
Clyde Tombaugh, Mars and UFOs — M. Swords

14:1 Investigating Deviations from Dynamical Randomness with Scaling Indices — Atmanspacher et al.
Valentich Disappearence: New Evidence and New Conclusion — R. Haines/P. Norman
Protection of Mice from Tularemia with Ultra-Low Agitated Dilutions — W. Jonas/D. Dillner
The Correlation of the Gradient of Shannon Entropy and Anomalous Cognition — Spottiswoode/Faith
Contributions to Variance in REG Experiments: ANOVA Models — R. Nelson et al.
Publication Bias: The "File-Drawer" Problem in Scientific Inference — J. Scargle
Remote Viewing in a Group Setting — R. Targ/J. Katra

14:2 Overview of Several Theoretical Models on PEAR Data — Y. Dobyns
The Ordering of Random Events by Emotional Expression — R. Blasband
Energy, Fitness and Information-Augmented EMFs in Drosophila melanogaster — M. Kohane/W. Tiller
A Dog That Seems To Know When His Owner Is Coming Home — R. Sheldrake/P. Smart
What Can Elementary Particles Tell Us about the World in Which We Live? — R. Bryan
Modern Physics and Subtle Realms: Not Mutually Exclusive — R. Klauber

14:3 Plate Tectonics: A Paradigm Under Threat — D. Pratt
The Effect of the "Laying On of Hands" on Transplanted Breast Cancer in Mice — Bengston/Krinsley
Stability of Assessments of Paranormal Connections in Reincarnation Type Cases — I. Stevenson/J. Keil
ArtREG: A Random Event Experiment Utilizing Picture-Preference Feedback — R. G. Jahn et al.
Can Population Growth Rule Out Reincarnation? — D. Bishai
The Mars Effect Is Genuine — S. Ertel/K. Irving
Bulky Mars Effect Hard To Hide — S. Ertel
What Has Science Come to? — H. Arp

14:4 Mind/Machine Interaction Consortium: PortREG Replication Experiments — Jahn/Mischo/Vaitl et al.
Unusual Play in Young Children Who Claim to Remember Previous Lives — I. Stevenson
A Scale to Measure the Strength of Children's Claims of Previous Lives — J. B. Tucker
Reanalysis of the 1965 Hefl in UFO Photos — Druffel/Wood/Kelson
Should You Take Aspirin To Prevent Heart Attack? — J. M. Kauffman

15:1 The Biomedical Significance of Homocysteine — K. McCully
20th and 21st Century Science: Reflections and Projections — R. G. Jahn
To Be Or Not To Be! A 'Paraphysics' for the New Millennium — J. E. Beichler
Science of the Future in Light of Alterations of Consciousness — I. Barušs
Composition Analysis of the Brazil Magnesium — P. A. Sturrock
Does Recurrent ISP Involve More Than Congnitive Neuroscience? — J.-C. Terrillon/S. Marques Bonham

15:2 The Scole Investigation: Critical Analysis of Paranormal Physical Phenomena — M. Keen
Bio-photons and Bio-communication — R. VanWijk
Scalar Waves: Theory and Experiments — K. Meyl

	Commentary: On Existence of K. Meyl's Scalar Waves	G. W. Bruhn
	Cases of the Reincarnation Type in South India: Why So Few Reports?	S. K. Pasricha
	Mind, Matter, and Diversity of Stable Isotopes	J. P. Pui/ A. A. Berezin
	Are the Apparitions of Medjugorge Real?	J. P. Pandarakalam
	Where Do We File 'Flying Saucers'? Archivist and Uncertainty Principle	H. Evans
	The Bakken: A Library and Museum of Electricity in Life	D. Stillings
15:3	A Modular Model of Mind/Matter Manifestations (M5)	R. G. Jahn/B. J. Dunne
	The Speed of Thought: Complex Space-Time Metric and Psychic Phenomenon	E. A. Rauscher/ R. Targ
	Failure to Replicate Electronic Voice Phenomenon	I. Barušs
	Experimental Study on Precognition	Vasilescu/Vasilescu
	Unexplained Temporal Coincidence of Crystallization	Constain/Davies
15:4	The Challenge of Consciousness	R. G. Jahn
	Anomalies and Surprises	H. H. Bauer
	Earth Geodynamic Hypotheses Updated	N. C. Smoot
	Unexplained Weight Gain Transients at the Moment of Death	L. E. Hollander, Jr.
	Physico-Chemical Properties of Water Following Exposure to Resonant Circuits	C. Cardella et al.
16:1	Can Physics Accommodate Clairvoyance, Precognition, and Psychokinesis?	R. Shoup
	The Pineal Gland and the Ancient Art of Iatromathematica	F. McGillion
	Confounds in Deciphering the Ramey Memo from the Roswell UFO Case	J. Houran/ K. D. Randle
	The Pathology of Organized Skepticism	L. D. Leiter
	Aspects of the Wave Mechanics of Two Particles in a Many Body Quantum System	Y. S. Jain
	Microscopic Theory of a System of Interacting Bosons: A Unifying New Approach	Y. S. Jain
	Unification of the Physics of Interacting Bosons and Fermions	Y. S. Jain
	The Pathology of Organized Skepticism	L. D. Leiter
16:2	Arguing for an Observational Theory of Paranormal Phenomena	J. M. Houtkooper
	Differential Event-Related Potentials to Targets and Decoys in Guessing Task	McDonough/ Don/Warren
	Stigmatic Phenomena: An Alleged Case in Brazil	S. Krippner
	The Case for the Loch Ness "Monster": The Scientific Evidence	H. H. Bauer
	What's an Editor To Do?	H. H. Bauer
16:3	M*: Vector Representation of the Subliminal Seed Regime of M5	R. G. Jahn
	Can Longitudinal Electromagnetic Waves Exist?	G. W. Bruhn
	Development of Certainty about the Deceased in Reincarnation Case in Lebanon	Haraldsson/ Izzeddin
	Manifestation and Effects of External Qi of Yan Xin Life Science Technology	Yan et al.
	Face-Like Feature at West Candor Chasma, Mars MGS Image AB 108403	Crater/Levasseur
	A Search for Anomalies	W. R. Corliss
	Common Knowledge about the Loch Ness Monster: Television, Videos, and Film	H. H. Bauer
16:4	Relationships Between Random Physical Events and Mass Human Attention	D. Radin
	Coherent Consciousness and Reduced Randomness: Correlations on 9/11/2001	R. D. Nelson
	Was There Evidence of Global Consciousness on September 11, 2001?	J. Scargle
	A Dog That Seems To Know When His Owner Is Coming Home	D. Radin
	An Investigation on the Activity Pattern of Alchemical Transmutations	J. Pérez-Pariente
	Anomalies in Relativistic Rotation	R. D. Klauber
	The Vardøgr, Perhaps Another Indicator of the Non-Locality of Consciousness	L. D. Leiter
	Review of the Perrott-Warrick Conference Held at Cambridge 3–5 April 2000	B. Carr

	Wavelike Coherence and CPT Invariance: Sesames of the Paranormal	O. Costa de Beauregard
	Why Only 4 Dimensions Will Not Explain Relationships in Precognition	Rauscher/Targ
17:1	Problems Reporting Anomalous Observations in Anthropology	C. Richards
	The Fringe of American Archaeology	A. B. Kehoe
	Rocks That Crackle and Sparkle and Glow: Strange Pre-Earthquake Phenomena	F. T. Freund
	Poltergeists, Electromagnetism and Consciousness	W. G. Roll
	AIDS: Scientific or Viral Catastrophe?	N. Hodgkinson
17:2	Information and Uncertainty in Remote Perception Research	B. J. Dunne/R. G. Jahn
	Problems of Reproducibility in Complex Mind-Matter Systems	H. Atmanspacher
	Parapsychology: Science or Pseudo-Science?	M.-C. Mousseau
	The Similarity of Features of Reincarnation Type Cases Over Many Years: A Third Study	I. Stevenson/ E. Haraldsson
	Communicating with the Dead: The Evidence Ignored. Why Paul Kurtz is Wrong	M. Keen
	Purported Anomalous Perception in a Highly Skilled Individual: Observations, Interpretations, Compassion	G. E. Schwartz/ L. A. Nelson/L. G Russek
	Proof Positive—Loch Ness Was an Ancient Arm of the Sea	F. M. Dougherty
17:3	Radiation Hormesis: Demonstrated, Deconstructed, Denied, Dismissed, and Some Implications for Public Policy	J. M. Kauffman
	Video Analysis of an Anomalous Image Filmed during Apollo 16	H. Nakamura
	The Missing Science of Ball Lightning	D. J. Turner
	Pattern Count Statistics for the Analysis of Time Series in Mind-Matter Studies	W. Ehm
	Replication Attempt: No Development of pH or Temperature Oscillations in Water Using Intention Imprinted Electronic Devices	L. I. Mason/ R. P. Patterson
	Three Cases of the Reincarnation Type in the Netherlands	T. Rivas
17:4	Testing a Language-Using Parrot for Telepathy	R. Sheldrake/ A. Morgana
	Skin Conductance Prestimulus Response: Analyses, Artifacts and a Pilot Study	S. J. P. Spottiswode /E. C. May
	Effects of Frontal Lobe Lesions on Intentionality and Random Physical Phenomena	M. Freedman/S. Jeffers/K. Saeger/ /M. Binns/S. Black
	The Use of Music Therapy as a Clinical Intervention for Physiologist	D. S. Berger/
	Functional Adaptation Media Coverage of Parapsychology and the Prevalence of Irrational Beliefs	D. J. Schneck/ M.-C. Mousseau
	The Einstein Mystique	I. McCausland
18:1	A Retrospective on the Journal of Scientific Exploration	B. Haisch/M. Sims
	Anomalous Experience of a Family Physician	J. H. Armstrong, Sr.
	Historical Overview & Basic Facts Involved in the Sasquatch or Bigfoot Phenomenon	J. Green
	The Sasquatch: An Unwelcome and Premature Zoological Discovery?	J. A. Bindernagel
	Midfoot Flexibility, Fossil Footprints, and Sasquatch Steps: New Perspectives on the Evolution of Bipedalism	D. J. Meldrum
	Low-Carbohydrate Diets	J. M. Kauffman
18:2	Analysis of the Columbia Shuttle Disaster— Anatomy of a Flawed Investigation in a Pathological Organization	J. P. MacLean/ G. Campbell/ S. Seals
	Long-Term Scientific Survey of the Hessdalen Phenomenon	M. Teodorani
	Electrodermal Presentiments of Future Emotions	D. I. Radin
	Intelligent Design: Ready for Prime Time?	A. D. Gishlick

On Events Possibly Related to the "Brazil Magnesium" — P. Kaufmann/P. A. Sturrock
Entropy and Subtle Interactions — G. Moddel
"Can a Single Bubble Sink a Ship?" — D. Deming

18:3 The MegaREG Experiment — Y. H. Dobyns et al.
Replication and Interpretation Time-Series Analysis of a Catalog of UFO Events: Evidence of a Local-Sidereal-Time Modulation — P. A. Sturrock
Challenging Dominant Physics Paradigms — J. M. Campanario/B. Martin
Ball Lightning and Atmospheric Light Phenomena: A Common Origin? — T. Wessel-Berg

18:4 Sensors, Filters, and the Source of Reality — R. G. Jahn/B. J. Dunne
The Hum: An Anomalous Sound Heard Around the World — D. Deming
Experimental Test of Possible Psychological Benefits of Past-Life Regression — K. Woods/I. Barušs
Inferences from the Case of Ajendra Singh Chauhan: The Effect of Parental Questioning, of Meeting the "Previous Life" Family, an Attempt To Quantify Probabilities, and the Impact on His Life as a Young Adult — A. Mills
Science in the 21st Century: Knowledge Monopolies and Research Cartels — H. H. Bauer
Organized Skepticism Revisited — L. D. Leiter

19:1 The Effect of a Change in Pro Attitude on Paranormal Performance: A Pilot Study Using Naive and Sophisticated Skeptics — L. Storm/M. A. Thalbourne
The Paradox of Planetary Metals — Y. Almirantis
An Integrated Alternative Conceptual Framework to Heat Engine Earth, Plate Tectonics, and Elastic Rebound — S. T. Tassos/D. J. Ford
Children Who Claim to Remember Previous Lives: Cases with Written Records Made before the Previous Personality Was Identified — H. H. Jürgen Keil/J. B. Tucker

19:2 Balls of Light: The Questionable Science of Crop Circles — F. Grassi/C. Cocheo/P. Russo
Children of Myanmar Who Behave like Japanese Soldiers: A Possible Third Element in Personality — I. Stevenson/J. Keil
Challenging the Paradigm — B. Maccabee
The PEAR Proposition — R. G. Jahn/B. J. Dunne
Global Warming, the Politicization of Science, and Michael Crichton's State of Fear — D. Deming

19:3 A State of Belief Is a State of Being — Charles Eisenstein
Anomalous Orbic "Spirit" Photographs? A Conventional Optical Explanation — G. E. Schwartz/K. Creath
Some Bodily Malformations Attributed to Previous Lives — S. K. Pasricha et al.
A State of Belief Is a State of Being — C. Eisenstein
HIV, As Told by Its Discoverers — H. H. Bauer
Kicking the Sacred Cow: Questioning the Unquestionable and Thinking the Impermissible — H. H. Bauer

19:4 Among the Anomalies — J. Clark
What Biophoton Images of Plants Can Tell Us about Biofields and Healing — K. Creath/G. E. Schwartz
Demographic Characteristics of HIV: I. How Did HIV Spread? — H. H. Bauer

20:1 Half a Career with the Paranormal — I. Stevenson
Pure Inference with Credibility Functions — M. Aickin
Questioning Answers on the Hessdalen Phenomenon — M. Leone
Hessdalen Research: A Few Non-Questioning Answers — M. Teodorani
Demographic Characteristics of HIV: II. How Did HIV Spread — H. H. Bauer
Organized Opposition to Plate Techtonics: The New Concepts in Global Tectonics Group — D. Pratt

20:2 Time-Normalized Yield: A Natrual Unit for Effect Size in Anomalies Experiments — R. D. Nelson
The Relative Motion of the Earth and the Ether Detected — S. J. G. Gift
A Unified Theory of Ball Lightning and Unexplained Atmospheric Lights — P. F. Coleman
Experimenter Effects in Laboratory Tests of ESP and PK Using a Common Protocol — C. A. Roe/R. Davey/P. Stevens
Demographic Characteristics of HIV: III. Why Does HIV Discriminate by Race — H. H. Bauer

20:3 Assessing the Evidence for Mind–Matter Interaction Effects — D. Radin et al.
Experiments Testing Models of Mind–Matter Interaction — D. Radin
A Critique of the Parapsychological Random Number Generator Meta-Analyses of Radin and Nelson — M. H. Schub
Comment on: "A Critique of the Parapsychological Random Number Generator Meta-Analyses of Radin and Nelson" — J. D. Scargle
The Two-Edged Sword of Skepticism: Occam's Razor and Occam's Lobotomy — H. H. Bauer

20:4 Consciousness and the Anomalous Organization of Random Events: The Role of Absorption — L. A. Nelson/G. E.Schwartz
Ufology: What Have We Learned? — M. D. Swords

21:1 Linking String and Membrane Theory to Quantum Mechanics & Special Relativity Equations, Avoiding Any Special Relativity Assumptions — M. G. Hocking
Response of an REG-Driven Robot to Operator Intention — R. G. Jahn et al.
Time-Series Power Spectrum Analysis of Performance in Free Response Anomalous Cognition Experiments — P. A. Sturrock/S. J. Spottiswoode
A Methodology for Studying Various Interpretations of the N,N-dimethyltryptamine-Induced Alternate Reality — M. A. Rodriguez
An Experimental Test of Instrumental Transcommunication — I. Barušs
An Analysis of Contextual Variables and the Incidence of Photographic Anomalies at an Alleged Haunt and a Control Site — D. B. Terhune et al.
The Function of Book Reviews in Anomalistics — G. H. Hövelmann
Ockham's Razor and Its Improper Use — D. Gernert
Science: Past, Present, and Future — H. H. Bauer

21:2 The Role of Anomalies in Scientific Exploration — P. A. Sturrock
The Yantra Experiment — Y. H. Dobyns et al.
An Empirical Study of Some Astrological Factors in Relation to Dog Behaviour Differences by Statistical Analysis & Compared with Human Characteristics — S. Fuzeau-Braesch/J.-B. Denis
Exploratory Study: The Random Number Generator and Group Meditation — L. I. Mason et al.
Statistical Consequences of Data Selection — Y. H. Dobyns

21:3 Dependence of Anomalous REG Performance on Run length — R. G. Jahn/Y. H. Dobyns
Dependence of Anomalous REG Performance on Elemental Binary Probability — R. G. Jahn/J. C. Valentino
Effect of Belief on Psi Performance in a Card Guessing Task — K. Walsh/G. Moddel
An Automated Online Telepathy Test — R. Sheldrake/M. Lambert
Three Logical Proofs: The Five-Dimensional Reality of Space–Time — J. E. Beichler
Children Who Claim to Remember Previous Lives: Past, Present, & Future Research — J. B. Tucker
Memory and Precognition — J. Taylor
AIDS, Cancer and Arthritis: A New Perspective — N. Hodgkinson
Online Historical Materials about Psychic Phenomena — C. S. Alvarado

21:4 Synthesis of Biologically Important Precursors on Titan Sam — H. Abbas/D. Schulze-Makuch/Wolfgang Helfrich
Is the Psychokinetic Effect as Found with Binary Random Number Generators Suitable to Account for Mind–Brain Interaction?

Explorations in Precognitive Dreaming	Dale E. Graff
Climate Change Reexamined	Joel M. Kauffman
Franklin Wolff's Mathematical Resolution of Existential Issues	Imants Barušs
From Healing to Religiosity	Kevin W. Chen

22:1	Theme and Variations: The Life and Work of Ian Stevenson	Emily W. Kelly/Carlos S. Alvarado
	Ian Stevenson: Recollections	Kerr L. White
	Reflections on the Life and Work of Ian Stevenson	Alan Gauld
	Ian Stevenson and Cases of the Reincarnation Type	Jim B. Tucker
	Ian Stevenson and the Modern Study of Spontaneous ESP Experiences	Carlos S. Alvarado/ Nancy L. Zingrone
	Ian Stevenson's Contributions to Near-Death Studies	Bruce Greyson
	Ian Stevenson's Contributions to the Study of Mediumship	Erlendur Haraldsson
	Where Science and Religion Intersect: The Work of Ian Stevenson	E. F. Kelly/E. W. Kelly
	The Gentle American Doctor	M.M. Abu-Izzeddin
	Professor Ian Stevenson—Some Personal Reminiscences	Mary Rose Barrington
	Ian Stevenson: A Recollection and Tribute	Stephen E. Braude
	Ian Stevenson and His Impact on Foreign Shores	Bernard Carr
	Ian Stevenson: Gentleman and Scholar	Lisette Coly
	The Quest for Acceptance	Stuart J. Edelstein
	Ian Stevenson: Founder of the Scientific Investigation of Human Reincarnation	Doris Kuhlmann-Wilsdorf
	Remembering My Teacher	L. David Leiter
	Comments on Ian Stevenson, M.D., Director of the Division of Personality Studies and Pioneer of Reincarnation Research	Antonia Mills
	Ian Stevenson: Reminiscences and Observations	John Palmer
	Dr. Ian Stevenson: A Multifaceted Personality	Satwant K. Pasricha
	A Good Question	Tom Shroder
	The Fight for the Truth	John Smythies
	Ian Stevenson: A Man from Whom We Should Learn	Rex Stanford
	Ian Stevenson and the Society for Scientific Exploration	Peter A. Sturrock
	Ian Stevenson's Early Years in Charlottesville	Ruth B. Weeks
	Tribute to a Remarkable Scholar	Donald J. West
	An Ian Stevenson Remembrance	Ray Westphal

22:2	Meditation on Consciousness	I. Ivtzan
	An Exploration of Degree of Meditation Attainment in Relation to Psychic Awareness with Tibetan Buddhists	S. M. Roney-Dougal J. Solfvin/J. Fox
	Thematic Analysis of Research Mediums' Experiences of Discarnate Communcation	A. J. Rock/J. Beischel G. E. Schwartz
	Change the Rules!	R. G. Jahn/B. J. Dunne
	Proposed Criteria for the Necessary Conditions for manicJourneying Imagery	A. J. Rock/S. Krippner
	"Scalar Wave Effects according to Tesla" & "Far Range Transponder"by K. Meyl	D. Kühlke
	How to Reject Any Scientific Manuscript	D. Gernert

22:3	Unusual Atmospheric Phenomena Observed Near the Channel Islands, United Kingdom, 23 April 2007	J.-F. Baure/D. Clarke/ P. Fuller/M. Shough
	The GCP Event Experiment: Design, Analytical Methods, Results	P. Bancel/R. Nelson
	New Insights into the Links between ESP and Geomagnetic Activity	Adrian Ryan
	Phenomenology of N,N-Dimethyltryptamine Use: A Thematic Analysis	C. Cott/A. Rock
	Altered Experience Mediates the Relationship between Schizotypy and Mood Disturbance during Shamanic-Like Journeying	A. Rock/G. Abbott/ N. Kambouropoulos
	Persistence of Past-Life Memories: Study of Adults Who Claimed in Their Childhood To Remember a Past Life	E. Haraldsson

22:4 Energy, Entropy, and the Environment (How to Increase the First by Decreasing the Second to Save the Third) — D. P. Sheehan
Effects of Distant Intention on Water Crystal Formation: A Triple-Blind Replication — D. Radin/N. Lund/M. Emoto/T. Kizu
Changes in Physical Strength During Nutritional Testing — C. F. Buhler/P. R. Burgess/E. VanWagoner
Investigating Scopesthesia: Attentional Transitions, Controls and Error Rates in Repeated Tests — Rupert Sheldrake/Pamela Smart
Shakespeare: The Authorship Question, A Bayesian Approach — P. A. Sturrock
An Anomalous Legal Decision — Richard Blasband

23:1 A New Experimental Approach to Weight Change Experiments at the Moment of Death with a Review of Lewis E. Hollander's Experiments on Sheep — Masayoshi Ishida
An Automated Test for Telepathy in Connection with Emails — R. Sheldrake/L. Avraamides
Brain and Consciousness: The Ghost in the Machines — John Smythies
In Defense of Intuition: Exploring the Physical Foundations of Spontaneous Apprehension — Ervin Laszlo

23:2 Appraisal of Shawn Carlson's Renowned Astrology Tests — Suitbert Ertel
A Field-Theoretic View of Consciousness: Reply to Critics — D. W. Orne-Johnson/Robert M. Oates
Super-Psi and the Survivalist Interpretation of Mediumship — Michael Sudduth
Perspectival Awareness and Postmortem Survival — Stephen E. Braude

23:3 Exploratory Evidence for Correlations between Entrained Mental Coherence and Random Physical Systems — Dean Radin/F. Holmes Atwater
Scientific Research between Orthodoxy and Anomaly — Harald Atmanspacher

23:4 Cold Fusion: Fact or Fantasy? — M. E. Little/S. R. Little
"Extraordinary Evidence" Replication Effort — M. E. Little/S. R. Little
Survey of the Observed Excess Energy and Emissions in Lattice-Assisted Nuclear Reactions — Mitchell R. Swartz

24:1 Rebuttal to Claimed Refutations of Duncan MacDougall's Experiment on Human Weight Change at the Moment of Death — Masayoshi Ishida
Unexpected Behavior of Matter in Conjunction with Human Consciousness — Dong Shen
Randomized Expectancy-Enhanced Placebo-Controlled Trial of the Impact of Quantum BioEnergetics and Mental Boundaries on Affect — Adam J. Rock/Fiona E. Permezel
A Case of the Reincarnation Type in Turkey Suggesting Strong Paranormal Information Involvements — Jürgen Keil
Questions of the Reincarnation Type — Jürgen Keil
How To Improve the Study and Documentation of Cases of the Reincarnation Type? A Reappraisal of the Case of Kemal Atasoy — Vitor Moura Visoni

24:2 Importance of a Psychosocial Approach for a Comprehensive Understanding of Mediumship — E. Maraldi/F. Machado/W. Zangari
Investigating Mental Mediums: Research Suggestions from the Historical Literature — Carlos S. Alvarado
Advantages of Being Multiplex — Michael Grosso
Some Directions for Mediumship Research — Emily W. Kelly
Parapsychology in France after May 1968: A History of GERP — Renaud Evrard
Remy Chauvin (1913–2009) — Renaud Evrard

24:3 Anomalous Magnetic Field Activity During a Bioenergy Healing Experiment — Margaret M. Moga/William F. Bengston

Further Evidence of the Possibility of Exploiting Anticipatory Physiological Signals To Assist Implicit Intuition of Random Events — Patrizio Tressoldi/M. Martinelli/Laura Scartezzini/Stefano Massaccesi
Fire in Copenhagen and Stockholm. Indridason's and Swedenborg's "Remote Viewing" Experiences — E. Haraldsson/Johan L. F. Gerding
Soal's Target Digits: Statistical Links Back to the Source He Reported After All — Roderick Garton
Common Paranormal Belief Dimensions — Neil Dagnall/Andrew Parker/Gary Munley/K. Drinkwater/
The 1907 Psychokinetic Experiments of Professor Filippo Bottazzi — Antonio Giuditta

24:4 Psi in a Skeptic's Lab: A Successful Replication of Ertel's Ball Selection Test — Suitbert Ertel
Anticipatory Alarm Behavior in Bengalese Finches — Fernando Alvarez
The Daniel Experiment: Sitter Group Contributions with Field RNG and MESA Recordings — Mike Wilson/Bryan J. Williams/Timothy M. Harte/William J. Roll
Field RNG Data Analysis, Based on Viewing the Japanese Movie Departures (Okuribito) — Takeshi Shimizu/Masato Ishikawa
The Healing Connection: EEG Harmonics, Entrainment, and Schumann's Resonan — Luke Hendricks/William F. Bengston/Jay Gunkelman
Laboratory Psi Effects May Be Put to Practical Use — James Carpenter

25:1 Are There Stable Mean Values, and Relationships between Them, in Statistical Parapsychology? — Wolfgang Helfrich
Exploring the Relationship between Tibetan Meditation Attainment and Precognition — Serena Roney-Dougal/Jerry Solfvin
A Faulty PK Meta-Analysis — Wilfried Kugel
Karhunen-Loève Transform for Detecting Ionospheric Total Electron Content (TEC) Anomalies Prior to the 1999 Chi-Chi Earthquake, Taiwan — Jyh-Woei Lin
Eusapia Palladino: An Autobiographical Essay — Carlos S. Alvarado
Mental Health of Mediums and Differential Diagnosis between Mediumship and Mental Disorders — Adair Menezes Jr./Alexander Moreira-Almeida

25:2 Objective Analyses of Real-Time and Audio Instrumental Transcommunication and Matched Control Sessions: A Pilot Study — Mark Boccuzzi/Julie Beischel
Measurement Controls in Anomalies Research — Walter E. Dibble Jr./William A. Tiller
Hessdalen Lights and Piezoelectricity from Rock Strain — Gerson S. Paiva/C. A. Taft
Retroactive Event Determination and the Interpretation of Macroscopic Quantum Superposition States in Consistent Histories and Relational Quantum Mechanics — Sky Nelson
Thoughts about Thought Bundles: A Commentary on Jürgen Keil's Paper "Questions of the Reincarnation Type" — Michael Nahm/Dieter Hassler
Reply to the Nahm and Hassler Commentary on Jürgen Keil's Paper "Questions of the Reincarnation Type" — Jürgen Keil
The Desire for the Development of Flight: A Recurrent Theme for Advanced Civilizations? — B. Reiswig/D. Schulze-Makuch

25:3 Reflections on the Context of Near-Death Experiences — Michael Nahm
An Important Subject at the Institut Métapsychique International: Jeanne LaPlace — Guilio Caratelli/Maria Luisa Felici
A Baby Sea-Serpent No More: Reinterpreting Hagelund's Juvenile "Cadborosaur" Report — M. A. Woodley/D. Naish/C. A. McCormick

Avian Formation on a South-Facing Slope Along the Northwest Rim of the Argyre Basin — Michael A. Dale/George J. Haas/James S. Miller/William R. Saunders/A. J. Cole/Susan Orosz/Joseph M. Friedlander
Guest Editorial: On Wolverines and Epistemological Totalitarianism — Etzel Cardeña

25:4 Revisiting the Ganzfeld Debate: A Basic Review and Assessment — Bryan J. Williams
The Global Consciousness Project: Identifying the Source of Psi — Edwin C. May/S. James P. Spottiswoode
Reply to May and Spottiswoode's on Experimenter Effect as the Explanation for GCP Results — Roger Nelson
Reply to May and Spottiswoode's "The Global Consciousness Project: Identifying the Source of Psi" — Peter Bancel
The Global Consciousness Project, Identifying the Source of Psi: A Response to Nelson and Bancel — Edwin C. May/S. James P. Spottiswoode
Alien Visitation, Extra-Terrestrial Life, and Paranormal Belief — Neil Dagnell/Kenneth Drinkwater/Andrew Parker
Anomalous Switching of the Bi-Stable Percept of a Necker Cube: A Preliminary Study — Dick J. Bierman
Color Distribution of Light Balls in the Hessdalen Lights Phenomenon — Gerson S. Paiva/Carlton A. Taft
On Elephants and Matters Epistemological: Reply to Etzel Cardeña's Guest Editoral "On Wolverines and Epistemological Totalitarianism" — Neal Grossman
Response to Neal Grossman's Reply "On Elephants and Matters Epistemological" — Etzel Cardeña
Ernesto Bozzano: An Italian Spiritualist and Psychical Researcher — Luca Gasperini
Obituary: In Memory of William Corliss — Patrick Huyghe
Letter: Pipefish or Pipedream? — Ed L. Bousfield/Paul H. LeBlond

26:1 A Review of Sir William Crooke's Papers on Psychic Force with Some Additional Remarks on Psychic Phenomena — Masayoshi Ishida
The Implications of Near-Death Experiences for Research into the Survival of Consciousness — David Rousseau
Remote Viewing the Future with a Tasking Temporal Outbounder — Courtney Brown
Relativistic Variations in the Permittivity and Permeability of Free Space = Gravitation — Graeme D. Montgomery
Historical Perspective: The Psychic Sciences in France: Historical Notes on the Annales des Science Psychiques — Carlos S. Alvarado/Renaud Evrard
Obituary: Dr. Stuart Appelle: 1946–2011 — Thomas E. Bullard
Letter: Response to Bousfield and LeBlond: Shooting Pipefish in a Barrel; or, Sauropterygian Mega-Serpents and Occam's Razor — Michael Woodley/Cameron McCormick/Darren Naish

26:2 A PK Experiment with Zebra Finches and a Virtual Predator — Fernando Alvarez
Revisiting the Alexander UFO Religious Crisis Survey (AUFORCS): Is There Really a Crisis? — Jeff Levin
Hallucinatory Telepathic Experiences Induced by Salvia divinorum — Grzegorz Juszcak
Hypnosis Reconsidered, Resituated, and Redefined — Adam Crabtree
Commentary: A Proposal That Does Not Advance Our Understanding of Hypnosis — Etzel Cardeña/Devin P. Terhune
Commentary: Comments on Crabtree's "Hypnosis Reconsidered, Resituated, and Redefined" — Charles T. Tart
Commentary: Regarding "Hypnosis Reconsidered, Resituated, and Redefined": A Commentary on Crabtree — Don Beere

Reply to Three Commenters on "Hypnosis Reconsidered, Resituated, and Redefined" — Adam Crabtree
Historical Perspective: The Sorcerer of Cobenzl and His Legacy: The Life of Baron Karl Ludwig von Reichenbach, His Work and Its Aftermath — Michael Nahm
Obituary: William Roll — Loyd Auerbach
Letter to the Editor: Erroneous Expert Judgments — Henry H. Bauer

26:3 Earthquake Triggering: Verification of Insights Obtained by Intuitive Consensus — William H. Kautz
Audience Size Effects in Field RNG Experiments: The Case of Japanese Professional Baseball Games — Takeshi Shimizu/Masato Ishikawa
Pranic Healing: Documenting Use, Expectations, and Perceived Benefits of a Little-Known Therapy in the United States — Maritza Jauregui/Tonya L. Schuster/Mary D. Clark/Joie P. Jones
A New Approach to Veridicality in Dream Psi Studies — Andrew Paquette
Historical Perspective: Distortions of the Past — Carlos S. Alvarado
Essay: The Review Reviewed: Stop Publication Bias — J. Alexander de Ru/John C.M.J. de Groot/Jan-Willem M. Elshof

26:4 The Bell Inequality and Nonlocal Causality — Charles W. Lear
Magnetic Anomalies and the Paranormal — John Ralphs
NDE Implications from a Group of Spontaneous Long-Distance Veridical OBEs — Andrew Paquette
Resonance between Birth Charts of Friends: The Development of a New Astrological Tool on the Basis of an Investigation into Astrological Synastry — Gerhard Mayer/Martin Garms
Historical Perspective: Notes on Early Mediumship — Carlos S. Alvarado
Essay: Seeking Immortality? Challenging the Drug-Based Medical Paradigm. SSE Dinsdale Award Address — Henry H. Bauer
Letter to the Editor: Identity of Shakespeare — James S. Ferris

27:1 Longitudinal Electromagnetic Waves? The Monstein-Wesley Experiment Reconstructed — Edward Butterworth/Charles B. Allison/Daniel Cavazos/Frank M. Mullen
The UFO Abduction Syndrome — Ted Davis/Don C. Donderi/Budd Hopkins
Description of Benveniste's Experiments Using Quantum-Like Probabilities — Francis Beauvais
Replication Attempt: Measuring Water Conductivity with Polarized Electrodes — Serge Kernbach
Commentary: The Influence of Reichenbach's Concept of Od — Carlos S. Alvarado
Obituary: Archie E. Roy Dies at 88 — Tricia Robertson
Letter to the Editor: Registering Parapsychological Experimentss — Caroline Watt
Letter to the Editor: Magnetic Anomalies and the Paranormal — Adrian Ryan
Letter to the Editor: Response to Adrian Ryan — John D. Ralphs

27:2 Use of a Torsion Pendulum Balance to Detect and Characterize What May Become a Human Energy Field — J. Norman Hansen/Joshua A. Lieberman
Geometry of an Intense Auroral Column as Recorded in Rock Art — M. A. van der Sluijs/Robert J. Johnson
Did Modern Humans Originate in the Americas? A Retrospective on the Holloman Gravel Pit in Oklahoma — David Deming
Experimental Birthmarks: New Cases of an Asian Practice — Jim B. Tucker/H. H. Jürgen Keil
Commentary: A Critical Response to David Lund's Argument for Postmortem Survival — Michael Sudduth
Obituary: Jack Houck (1939–2013) — John Alexander
Obituary: Ted Rockwell (1922–2013) — John Alexander

27:3 Psi Effects or Sensory Leakage: Scrutinzing the Bell Selection Test — Suitbert Ertel
The Sheep–Goat Effect as a Matter of Compliance vs. Noncompliance: The Effect of Reactance in a Forced-Choice Ball Selection Test — Lance Storm/S. Ertel/Adam Rock
Unidentified Aerial Phenomena (UAP): A New Hypothesis Toward The Explanation — Daniel M. Gross
Building Alien Worlds—The Neuropsychology and Evolutionary Implications of the Astonishing Psychoactive Effects of N,N-Dimethyltryptamine (DMT) — Andrew R. Gallimore
Historical Perspective: Three Stages of Modern Science — Henry H. Bauer

27:4 Hum and Otoacoustic Emissions May Arise Out of the Same Mechanisms — Franz G. Frosch
A Case of a Japanese Child with Past-Life Memories — Masayuki Ohkado
Unidentified Aerial Phenomena: The VASP-169 Flight Brazilian Episode Revisited — Luiz Augusto daSilva
Historical Perspective: Nineteenth Century Psychical Research in Mainstream Journals: The Revue Philosophique de la France et de l'Etranger — Carlos s. Alvarado/Renaud Evrard

28:1 Stock Market Prediction Using Associative Remote Viewing by Inexperienced Remote Viewers — Christopher Carson Smith/Darrell Laham/Garret Moddel
An Experimental Study for Reproduction of Biological Anomalies Reported in the Hoeven 1999 Crop Circle — Eltjo H. Haselhoff/Robert J. Boerman/Jan-Willem Bobbink
Pre-Columbian Transoceanic Influences: Far-Out Fantasy, Unproven Possibility, or Undeniable Reality? — Stephen C. Jett
G. Stanley Hall on "Mystic or Borderline Phenomena" — Carlos S. Alvarado
Anomalistics, Pseudo-Science, Junk Science, Denialism: Corollaries of the Role of Science in Society — Henry H. Bauer
Letter to the Editor: Exaggerated Emphasis — Peter A. McCue

28:2 The Development and Phenomena of a Circle for Physical Mediumship — Michael Nahm
Investigations of the Felix Experimental Group: 2011–2013 — Stephen E. Braude
Commentary: On the Essay Review "William Jackson Crawford on the Goligher Circle" by Michael Tymn — Michael Nahm
Commentary: On W. J. Crawford's Studies of Physical Mediumship — Carlos S. Alvarado
Obituary: Halton Christian "Chip" Arp, 1927–2013 — Peter A. Sturrock

28:3 Anomalous 'Retrocausal' Effects on Performances in a Go/NoGo Task — Dick J. Bierman/Aron Bijl
An Investigation of Solar Features, Test Environment, and Gender Related to Consciousness-Correlated Deviations in a Random Physical System — Joey M. Caswell/Lyndon M. Juden-Kelly/David A. E. Vares/Michael A. Persinger
Children with Life-between-Life Memories — Ohkado Masayuki/Ikegawa Akira
Essay: Shasmans of Scientism: Conjuring Certainty Where There Is None — Henry H. Bauer
Obituary: Eileen Coly (1916-2013) — Carlos S. Alvarado/Nancy Zingrone

28:4 Psychological Evaluation of American Children Who Report Memories of Previous Lives — Jim B. Tucker/F. Don Nidiffer
Facial Features of Burmese with Past-Life Memories as Japanese Soldiers — Ohkado Masayuki
Parapsychological Phenomena as Examples of Generalized Nonlocal Correlations—A Theoretical Framework — Harald Walach/Walter von Lucadou/Hartmann Römer
Aberrant Salience and Motivation as Factors in the Formation of Beliefs in Scientifically Unacceptable Phenomena — Harvey J. Irwin
Historical Perspective: Does a Cosmic Ether Exist? Evidence from Dayton Miller and Others — James DeMeo
Obituary: John O'M. Bockris, 1923–2013 — Edmund Storms

Review: Crimes of Reason by Stephen Braude — Stan McDaniel
Review: Las Alas de Psique [The Wings of Psyche] by Alejandro Parra — Carlos A. Alvarado
Review: The Spiritualist Movement edited by Christopher Moreman — Alan Gauld
Review: One Mind by Larry Dossey — Roger Nelson
Review: Bava's Gift by Michael Urheber — Bob Ginsberg

29:1 Twitter Followers Biased to Astrological Charts of Celebrities — Renay Oshop/Andrew Foss
The Human Bioenergy Field Detected by a Torson Pendulum? The Effect of Shielding and a Possible Conventional Explanation — Willem H. van den Berg/ William G. van der Sluys
Commentary: Reply to van den Berg and van der Sluys: Effects Resembling a Biofieldon a Torsion Pendulum Cannot Be Caused by the Subject — John Norman Hansen/ Joshua A. Lieberman
Commentary: Response to Hansen and Lieberman — Willem H. van den Berg/ William G. van der Sluys
Introduction to Honorton Article and Pilkington Interview with Parise — Stephen E. Braude
Commentary: A Moving Experience [reprinted from JASPR] — Charles Honorton
Commentary: Interview with Felicia Parise, August 6, 2013 — Rosemarie Pilkington
Historical Perspective: Note on an Early Physiological Index of ESP John Purdon's Observations of Synchronous Pulse Rates — Carlos S. Alvarado

29:2 Modeling the Law of Times — Julio Plaza del Olmo
Can Solar Activity Influence the Occurrence of Economic Recessions? — Mikhail Gorbanev
A Correlation Study between Human Intention and the Output of a Binary Random Event Generator — H. Grote
Commentary on "Does a Cosmic Ether Exist? Evidence from Dayton Miller and Others" — Robert D. Klauber
Commentary: The Ether and Psychic Phenomena: Some Old Speculations — Carlos S. Alvarado
Commentary: The Importance of Retractions and the Need to Correct the Downstream Literature — Jaime A. Teixeira da Silva
Essay: Essay Review of The Survival Hypothesis — Alan Gauld

29:3 Can Death-Related Dreams Predict Future Deaths? Evidence from a Dream Journal Comprising Nearly 12,000 Dreams — Andrew Paquette
A Review on the Relation between Population Density and UFO Sightings — Julio Plaza del Olmo
Multivariate Entropy Analysis of Oxidative Stress Biomarkers Following Mobile Phone Exposure of Human Volunteers: A Pilot Study — Anthony Marconi Albert Tasteyre/ René de Sèze/Paul Fogel/Guy Simoneau/Marc Conti/Christian Sarbach/S. Stanley Young/Jean-Emmanuel Gilbert/Yolène Thomas
Historical Perspective: Telepathic Emissions: Edwin J. Houston on "Cerebral Radiation" — Carlos S. Alvarado
Letter to the Editor: Quality in Parapsychological Meta-Analyses — Dick J. Bierman

29:4 Testing Telepathy in the Medium/Proxy-Sitter Dyad: A Protocol Focusing on the Source-of-Psi Problem — Adam J. Rock/ Lance Storm
Shortage of Rabbits or Insufficient Traps? Table-Turning and the Discovery of a Presumably PK-Gifted person in Argentina — Juan Gimeno
Essay: The Unbearable Fear of Psi: On Scientific Suppression in the 21st Century — Etzel Cardeña
Appendix 1: Introduction to Non-Ordinary Mental Expressions — Etzel Cardeña/ Enrico Facco
Essay Review: Climate Change Science or Climate-Change Propaganda? Climate Change: Evidence & Causes—An Overview from the Royal Society and the U.S. National Academy of Sciences — Henry H. Bauer

Commentary: Professor Bauer Has It Backwards — Peter A. Bancel
Commentary: Notes on the Essay Review of Climate Change: Evidence and Causes, by Henry Bauer — Andrew Foss
Commentary: Response to Commentaries by Peter Bancel and Andrew Foss — Henry H. Bauer
Letter to the Editor: Is Consensus in Science Good? — Ron Westrum

30:1 Prospective Statistical Power: Sample Size Recommendations for the Investigation of the Main Parapsychological Phenomena — William F. Krupke
Consistency in Eyewitness Reports of Aquatic "Monsters" — Charles G. M. Paxton & A. J. Shine
Follow-Up Investigations of the Felix Circle — Stephen E. Braude
Commentary: Further Comments about Kai Mügge's Alleged Mediumship and Recent Developments — Michael Nahm
Historical Perspective: On Psychic Forces and Doubles: The Case of Albert de Rochas — Carlos S. Alvarado
Letter to the Editor: Physical Mediumship: Trying to Move On — Zofia Weaver
Letter to the Editor: A Recent Instance of Psi Censorship in Psychological Science? — Gary E. Schwartz
Obituary: Edgar D. Mitchell, 1930–2016 — John Alexander
Obituary: Richard (Dick) G. Shoup, 1943–2015 — James Spottiswoode

30:2 Sonic Analysis of the Redlands UFO Tape Recording — Patrizio Tressoldi
The Rarity of Unambiguous Symbols in Dreams: A Case Study — Andrew Paquette
An Experiment on Precognition with Planarian Worms — Fernando Alvarez
Commentary: On Marc Thury's Les Tables Tournantes — Carlos S. Alvarado
Historical Perspective: Revealing the Real Madame d'Esperance: An Historical and Psychological Investigation — Adrian Parker
Elisabeth Warwood

30:3 Use of a Torsion Pendulum Balance to Detect and Characterize What May Be a Human Bioenergy Field — Joshua A. Lieberman
Geometry of an Intense Auroral Column as Recorded in Rcck Art — Marinus Anthony van der Sluijs
Robert J. Johnson
Did Modern Humans Originate in the Americas? A Retrospective on the Holloman Gravel Pit in Oklahoma — David Deming
Experimental Birthmarks: New Cases of an Asian Practice — Jim Tucker/H. H. Jürgen Keil
Commentary: A Critical Response to David Lund's Argument for Postmortem Survival — Michael Sudduth
An Historical and Psychological Investigation — Elisabeth Warwood
Obituary: Jack Houck (1939-2013) — John Alexander
Obituary: Ted Rockwell (1922-2013) — John Alexander

30:4 Strange Handprints in Strange Places — Allison Zumwalde/Kendall Ciriaco/John Allison
A Same-Family Case of the Reincarnation Type in Japan — Ohkado Masayuki
Apport Phenomena of Medium Herbert Baumann (1911–1998): Report on Personal Experiences — Illobrand von Ludwiger/Michael Nahm

31:1 Anomalus/Paranormal Experiences Reported by Nurses in Relation to Their Patients in Hospitals — Alejandro Parra/Paola Giménez Amarilla
On the Resurrection of Trans-Temporal Inhibition — Charles Tart
New Paradigm Research in Medicine: An Agenda — Jeff Levin
Anomalous Phenomena and the Scientific Mind: Some Insights from "Psychologist" Louis Favre (1868–1938?) — Renaud Evrard
The Challenge of Ball-Lighning: Evidence of a "Parallel Dimension"? — Peter Sturrock

31:2 Laboratory Research on a Presumably PK-Gifted Subject — Juan Gimeno/Dario Burgo
A Question of Belief: An Analysis of Item Content in Paranormal Questionnaires — Lance Storm/Ken Drinkwater/Anthony L. Jinks
Multiple-Analysis Correlation Study beetween Human Psychological Variables and Binary Random Events — Hartmut Grote
Telepathy, Mediumship, and Psychology: Psychical Research at the International Congresses of Psychology, 1889-1905 — Carlos S. Alvarado

31:3 Statistical Parapsychology as Seen by an Applied Physicist — Wolfgang Helfrich
Eisenbud, Smias, and Psi — Jason Kissner
The Mediumship of Carlos Mirabelli (1889–1951 — Stephen E. Braude
Telepathy, Mediumship, and Psychology: Psychical Research at the Selected Aspects of Carlos Mirabelli's Mediumship — Michael Nahm

31:4 Same-Family Cases of the Reincarnation Type in Japan — Ohkado Masayuki
A Test of an Occult-Theme Seance: Examining Anomalous Events, Psychosomatic Symptoms, Transliminality, and Electromagnetic Fields — Brian Laythe/Elizabeth Cooper Laythe/Lucinda Woodward
Historical Perspective: William Shakespeare: A Study of the Poet and Five Famous Contemporaries Who Between Them Used the Rune Ciphers to Reveal His True Identity — David L. Roper
Essay: Shakespeare: The Authorship Question, A Bayesian Approach [reprinted from a 2008 JSE article] — Peter A. Sturrock
Obituary: Yvonne Duplessis, 1912–2017 — Renaud Evrard

32:1 On Carving Realilty at Its Joints: Black Holes and Process, People, and an Experimental Challenge — Chris Nunn
An Ethnographic Assessment of Project Firefly: A Yearlong Endeavor to Create Wealth by Predicting FOREX Currency Moves with Associative Remote Viewing — Debra Katz/Igor Grgić/T. W. Fendley
Historical Perspective: Fragments of a Life in Psychical Research: The Case of Charles Richet — Carlos S. Alvarado
Historical Perspective: Mediumistic Phenomena Part I by Julian Ochorowicz translated by Casimir Bernard and Zofia Weaver — Zofia Weaver
Essay: Toward a "Science of the Subjective": Reminiscences and Speculations in Memory and in Honor of Bob Jahn — Henry H. Bauer
Essay: A Tribute to Bob Jahn — York Dobyns
Essay: Lab Coat and Turban, a Tribute to Robert G. Jahn — Roger D. Nelson
Essay: Remembrance of Bob Jahn — Tony Edwards
Essay: A Personal Tribute to Bob Jahn — William Bengston

32:2 Observer Effects on Quantum Randomness: Testing Micro-Psychokinetic Effects of Smokers on Addiction-Related Stimuli — Markus A. Maier/Moritz C. Deschamps
A Study on Reported Contact with Non-Human Intelligence Associated with Unidentified Aerial Phenomena — Reinerio Hernandez/Robert Davis Russell Scalpone/Rudolph Schild
Historical Perspective: Mediumistic Phenomena Part II by Julian Ochorowicz, translated by Casimir Bernard and Zofia Weaver — Casimir Bernard/Zofia Weaver
Obituary: Bob Jahn: Co-Founder of SSE — Peter A. Sturrock

32:3 The Effects of Geophysical Anomalies on Biology — Lydia Giannoulopoulou/Angelos Evangelou Spyros Karkabounas/Stavros Papamarinopoulos
A Methodology Proposal for Conducting a Macro-PK Test on Light-Spinning Objects in a Non-Confined Environment — Eric Dullin/David Jamet

Prediction of Mental Illness Using Indian Astrology: Cross-Sectional Findings from a Prospective Study — Rajeshkrishna Panambur Bhandary/ Podila Satya Venkata/ Narashimha Sharma/Hema Tharoor
Commentary: Investigating "Physical Mediums" via Audio Signal Processing: A Comment on a Recent Approach — Michael Nahm
Ochorowicz, translated by Casimir Bernard and Zofia Weaver — Zofia Weaver
Historical Perspective: Note on the Intellectual Work of William Stainton Moses — Carlos S. Alvarado
Obituary: Tribute to Guy Lyon Playfair (1935–2018) — Alan Murdie

32:4 Experimenter Psi Effect in Precognition Tests with Planarians — Fernando Alvarez
A Methodology Proposal for Conducting a Macro-PK Test on Light-Spinning Objects in a Non-Confined Environment — Eric Dullin/ David Jamet
Human Mental Intentionality on the Aesthetics of Cooked Rice and Escherichia coli Growth — Alan W. L. Lai/ Bonny B. H. Yuen/ Richard Burchett
Brief Research: A Follo-Up Study on Unusual Perceptual Experiences in Hospital Settings Related by Nurses — Alejandro Parra
Commentary: Experimental Replicability — Henry H. Bauer
Historical Perspective: Table Turning in the Early 1850s: The Séance Reports of Agénor de Gasparin — Carlos S. Alvarado
Letter to the Editor: JSE Tributes to Bob Jahn — Brenda J. Dunne

33:1 Coincidence or Psi? The Epistemic Import of Spontaneous Cases of Purported Psi Identified Post-Verification — Sharon Hewitt Rawlette
Two Attempted Retro-Priming Replications Show Theory-Relevant Anomalous Connectivity — Jacob Jolij / Dick Bierman
Review: The Case for Advance Wave Causality — Charles W. Lear
Historical Perspective: Musings on Materializations: Eric J. Dingwall on "The Plasma Theory" — Carlos S. Alvarado
Letter to the Editor: Preparing for the Death of a Loved one — Robert Ginsberg

33:2 Imagination and Reactance in a Psi Task Using the Imagery Cultivation Model and a Fuzzy Set Encoded Target Pool — Lance Storm
Homeopathy and the Action of Meaning: A Theoretical Approach — Walter v. Lucadou
A Camera-Based Tracking System for Ouija Research — Eckard Kruse

33:3 Editorial: Why Do Ghosts Wear Clothes? — Stephen E. Braude
Guest Editorial: On the Potential Role of Psi in an Expanded Science of the Physical, Experientail, and Spiritual — Charles T. Tart
How Smokers Change Their World and How the World Responds: Testing the Oscillatory Nature of Micro-Psychokinetic Observer Effects on Addiction-Related Stimuli — Moritz D. Dechamps / Markus A. Maier
A Multi-Frequency Replicaton of the MegaREG Experiments — Keith Alexandr
The Location and Reconstructionof a Byzantine Structure in Marea, Egypt, Including a Comparison of Electronic Remote Sensing and Remote Viewing — Stephan A. Schwartz

33:4 Imagination and Reactance in a Psi Task Using the Imagery Cultivation Model and a Fuzzy Set Encoded Target Pool — Lance Storm
Homeopathy and the Action of Meaning: A Theoretical Approach — Walter v. Lucadou
A Camera-Based Tracking System for Ouija Research — Eckard Kruse

34:1 Editorial: Cosmic Aesthetics — Stephen E. Braude
Development and Deployment of the Windbridge Psi and Related Phenomena Awareness Questionnaire (WPRPAQ) — Julie Beischel, Mark Boccuzzi
The Discovery of an American Brig: Fieldwork Involving Applied Remote Viewing Including a Comparison with Electronic Remote Sensing — Stephan A. Schwartz, Randall J. De Mattei
Essay: Loch Ness Monsters as Cryptid (Presently Unknown) Sea Turtles — Henry H. Bauer
Letter to the Editor: Time to Celebrate! — Michael Nahm
Essay Review: Disappointing "Documentary about Loch Ness Monsters ("Nessies"): (Can Good Documentaries Be Made about Such Subjects?) **Loch Ness Monster New Evidence** by Travel Channel — Henry H. Bauer
Essay Review: Phone Calls from the Dead? Exploring the Role of the Trickster. **Des coups de fil de l'AU-DELÀ? Enquête sur un phénomènon paranormal incroyable: Sa folie, ses caractéristiques et son explication** by Laurent Kasprowicz — Sharon Hewitt Rawlette
34:2 Editorial: Does Telepathy Threaten Mental Privacy? — Stephen E. Braude
A New Model to Explain the Alignment of Certain Ancient Sites — Mark J. Carlotto
Mind Control of a Distant Electronic Device: A Proof-of-Concept Pre-Registered Study — Patrizio Tressoldi, Luciano Pederozoli, Elena Pratti, Luca Semenzato
The Global Consciousness Project's Event-Related Responses Look Like Brain EEG Event-Related Potentials — Roger G. Nelson
Behind the Mask: An Analysis of the Dedication of Shakespeare's Sonnets and Its Implications for the Authorship Question — Peter A. Sturrock, Kathleen E. Erickson
Commentary: New Life for Cold Fusion — Henry H. Bauer
Essay Review: **The Star Gate Archives, Volumes 1–4, Reports of the U.S. Government Sponsored Psi Program 1972–1995** edited by Edwin C. May and Sonali Bhatt Marwaha — Damien Broderick
Essay Review: Scientocracy: Why a Science Court is Needed **Scientocracy: The Tangled Web of Public Science and Public Policy** edited by Patrick J. Michaels and Terence Kealey — Henry H. Bauer
34:3 Editorial: More Terminological Blunders — Stephen E. Braude
Quantifying Biofield Therapy through Biophoton Emission in a Cellular Model — Jeremy B. Kent, Li Jin, Xudong Joshua Li
Mysticism and the Fine Structure Constant — Philip R. Brown
Psychedelic Telepathy: An Interview Study — Petter Grahl Johnstad
Historical Perspective: Maxwell Zombies: Mulling and Mauling the Second Law of Thermodynamics — D. P. Sheehan
Historical Perspective: Dissociation and the Unconscious Mind: Nineteenth-Century Perspectives on Mediumship — Carlos S. Alvarado
Obituary: A Parapsychological Naturalisst: A Tribute to Mary Rose Barrington (January 31, 1926–February 20, 2020) — Zofia Weaver
Letter to the Editor: Quantum Turbulence — Kostas Davanas
Letter to the Editor: Flying Friars and Other Exceptions — Michael Grosso

34:4	Editorial: Scientific Certitude	Stephen E. Braude
	Using Virtual Reality to Test for Telepathy: A Proof-of-Concept Study	David Vernon Thomas Sandford Eric Moy
	Dealing with the Experimenter Effect	Dick J. Bierman Jacob J. Jolij
	Commentary: Early Spiritualist Discussions about the Distortions of Mediumistic Communications	Carlos S. Alvarado
	Historical Perspective: Early Psychical Research Reference Works: Remarks on Nandor Fodor's **Encyclopaedia of Psychic Science**	Carlos S. Alvarado
	Historical Perspective: Astrology and Science: A Precarious Relationship. Part 1: Historical Review of German Astrology in the 20th Century and Current Developments	Gerhard Mayer
	Essay: Astrology and Science: A Precarious Relationship. Part 2: Consideration of Empirical Investigations on the Validity of Astrology	Gerhard Mayer
35:1	Editorial: JSE's First Retraction	Stephen E. Braude
	Associative Remote Viewing for Profit: Evaluating the Importance of the Judge and the Investment Instrument	John G. Kruth
	The Psychology and Parapsychology of Spiritual Emergency	Lance Storm
	Two Replication Studies of a Time-Reversed (Psi) Priming Task and the Role of Expectancy in Reaction Times	Marilyn Schlitz et al.
	Commentary: Thought-Forms Gone Rogue: A Theory for Psi-Critics and Parapsychologists	Adrian Parker
	Letter to the Editor: Another Cryptogram in "Shakespeare's" Dedication of His Sonnets	Harald Walach
	Obituary: Erlendur Haraldsson: An Appreciation	Jim B. Tucker
	Retraction: Retraction of: Parra, A., & Gimenez Amarilla, P. (2017), Anomalous/paranormal experiences by nurses in relation to their patients, Journal of Scientific Exploration, 31(1), 11–28	

SOCIETY FOR
SCIENTIFIC EXPLORATION

GIFT *JSE* ISSUES & SSE MEMBERSHIPS, BACK ISSUES

Single Issue: A single copy of this issue can be purchased.
For back issues from 2010 to present in print, contact
membership@scientificexploration.org

Price: $20.00 EACH

Online Access: **All issues and articles from Volume 1 to present can be read for free at** https://www.scientificexploration.org/journal-library

Subscription: To send a gift subscription, fill out the form below.

Price: $85 (online)/$145(print & online) for an individual
$165/$225 (online only/print) for library/institution/business

Gift Recipient Name _____

Gift Recipient Address _____

_____

Email Address of Recipient for publications_____

- ☐ I wish to purchase a single copy of the current JSE issue.
- ☐ I wish to remain anonymous to the gift recipient.
- ☐ I wish to give a gift subscription to a library chosen by SSE.
- ☐ I wish to give myself a subscription.
- ☐ I wish to join SSE as an Associate Member for $85/yr or $145/yr (print), and receive this quarterly journal (plus the EdgeScience magazine and The Explorer newsletter).

Your Name _____

Your Address _____

_____

Send this form to: Journal of Scientific Exploration
Society for Scientific Exploration
P. O. Box 8012
Princeton, NJ 08543-8012

Membership@ScientificExploration.org
Phone (1) (609) 349-8059

For more information about the Journal *and the Society, go to*
https://www.scientificexploration.org

SOCIETY FOR
SCIENTIFIC EXPLORATION

JOIN THE SOCIETY AS A MEMBER

Join online at https://www.scientificexploration.org/join

The Society for Scientific Exploration has four member types:

Associate Member ($85/year with online Journal; $145 includes print Journal): Anyone who supports the goals of the Society is welcome. No application material is required.

Student Member ($40/year includes online Journal; $100/year includes print Journal): Send proof of enrollment in an accredited educational institution.

Full Member ($125/year for online Journal; $185/year includes Print Journal): Full Members may vote in SSE elections, hold office in SSE, and present papers at annual conferences. Full Members are scientists or other scholars who have an established reputation in their field of study. Most Full Members have: a) doctoral degree or equivalent; b) appointment at a university, college, or other research institution; and c) a record of publication in the traditional scholarly literature. Application material required: 1) Your curriculum vitae; 2) Bibliography of your publications; 2) Supporting statement by a Full SSE member; or the name of Full SSE member we may contact for support of your application. Send application materials to SSE Secretary Mark Urban-Lurain, scientificexplorationsecretary@gmail.com

Emeritus Member ($85/year with online Journal; $145/year includes print Journal): Full Members who are now retired persons may apply for Emeritus Status. Please send birth year, retirement year, and institution/company retired from.

All SSE members receive: online quarterly *Journal of Scientific Exploration* (*JSE*), *EdgeScience* online magazine, *The Explorer* online newsletter, notices of conferences, access to SSE online services, searchable recent *Journal* articles from 2008–current on the JSE site by member password, and for all 25 years of previous articles on the SSE site. For additional new benefits, see World Institute for Scientific Exploration, instituteforscientificexploration.org

Your Name _____

_____

Email_____

Phone_____ Fax_____

Payment of _____ enclosed, *or*

Charge My VISA ☐ Mastercard ☐

Card Number _____ Expiration_____

Send this form to:

Society for Scientific Exploration
P. O. Box 8012
Princeton, NJ 08543-8012
Membership@ScientificExploration.org
Phone (1) (609) 349-8059

For more information about the Journal *and the Society, go to*
https://www.scientificexploration.org

JOURNAL OF SCIENTIFIC EXPLORATION
A Publication of the Society for Scientific Exploration

Instructions for Authors (Revised October 2018)

JSE is an open access journal, with a CC-BY-NC license. There are no submission fees, no reader fees, no author page charges, and no open access fees. Please submit all manuscripts at http://journalofscientificexploration.org/index.php/jse/login (please note that "www" is NOT used in this address). This website provides directions for author registration and online submission of manuscripts. Full Author Instructions are posted on the Society for Scientific Exploration's website at https://www.scientificexploration.org/documents/instructions_for_authors.pdf for submission of items for publication in the *Journal of Scientific Exploration* (including "Writing the Empirical Journal Article." Before you submit a paper, please familiarize yourself with the *Journal* by reading *JSE* articles. Back issues can be read at https://www.scientificexploration.org/journal-library, scroll down to the Open Access issues. Electronic files of text, tables, and figures at resolution of a minimum of 300 dpi (TIF or PDF preferred) will be required for online submission. You will also need to attest to a statement online that the article has not been previously published and is not submitted elsewhere. The Journal uses the *APA Publication Manual 7th edition* as its style guide.

JSE Managing Editor: Journal@ScientificExploration.org

AIMS AND SCOPE: The *Journal of Scientific Exploration* publishes material consistent with the Society's mission: to provide a professional forum for critical discussion of topics that are for various reasons ignored or studied inadequately within mainstream science, and to promote improved understanding of social and intellectual factors that limit the scope of scientific inquiry. Topics of interest cover a wide spectrum, ranging from apparent anomalies in well-established disciplines to rogue phenomena that seem to belong to no established discipline, as well as philosophical issues about the connections among disciplines. The *Journal* publishes research articles, review articles, essays, book reviews, and letters or commentaries pertaining to previously published material.

REFEREEING: Manuscripts will be sent to one or more referees at the discretion of the Editor-in-Chief. Reviewers are given the option of providing an anonymous report or a signed report.

In established disciplines, concordance with accepted disciplinary paradigms is the chief guide in evaluating material for scholarly publication. On many of the matters of interest to the Society for Scientific Exploration, however, consensus does not prevail. Therefore the *Journal of Scientific Exploration* necessarily publishes claimed observations and proffered explanations that will seem more speculative or less plausible than those appearing in some mainstream disciplinary journals. Nevertheless, those observations and explanations must conform to rigorous standards of observational techniques and logical argument.

If publication is deemed warranted but there remain points of disagreement between authors and referee(s), the reviewer(s) may be given the option of having their opinion(s) published along with the article, subject to the Editor-in-Chief's judgment as to length, wording, and the like. The publication of such critical reviews is intended to encourage debate and discussion of controversial issues, since such debate and discussion offer the only path toward eventual resolution and consensus.

LETTERS TO THE EDITOR intended for publication should be clearly identified as such. They should be directed strictly to the point at issue, as concisely as possible, and will be published, possibly in edited form, at the discretion of the Editor-in-Chief.

PROOFS AND AUTHOR COPIES: Authors will receive copyedited, typeset page proofs for review. Print copies of the published Journal will be sent to all named authors if requested.

DISCLAIMER: While every effort is made by the Publisher, Editors, and Editorial Board to see that no inaccurate or misleading data, opinion, or statement appears in this *Journal*, they wish to point out that the data and opinions appearing in the articles and announcements herein are the sole responsibility of the contributor concerned. The Publisher, Editors, Editorial Board, and their respective employees, officers, and agents accept no responsibility or liability for the consequences of any such inaccurate or misleading data, opinion, or statement.

EDITORIAL

261 The Need for Negativity
Stephen E. Braude

RESEARCH ARTICLES

267 EEG Activity During Mental Influence on a Random Signal Generator
William Giroldini, Luciano Pederzoli

287 Mind–Matter Entanglement Correlations: Blind Analysis of a New Correlation Matrix Experiment
Hartmut Grote

311 The Effects of Meditation and Visualization on the Direct Mental Influence of Random Event Generators
Tayzia Collesso, Maria Forrester, Imants Barušs

345 Phenomenological Interpretations of Some Somatic Temporal and Spatial Patterns of Biophoton Emission in Humans
Daqing Piao

COMMENTARY

383 Reply to: Grote, H. (2018). Commentary: Intentional observer effects on quantum randomness: A Bayesian analysis reveals evidence against micro-psychokinesis
Markus A. Maier, Moritz C. Dechamps, Günter Schiepek

BOOK REVIEWS

389 Historical Views of Spiritism and Mediumship in Spain, 1880–1930
Ciencia y Espiritismo en España, 1880–1930 [Science and Spiritism in Spain, 1880–1930] by Andrea Graus
Carlos S. Alvarado

405 Has Physics Theory Become Vacuous?
Lost in Math: How Beauty Leads Physics Astray by Sabine Hossenfelder
Henry H. Bauer

415 *Sensitive Soul: The Unseen Role of Emotion in Extraordinary States* by Michael A. Jawer
Robert S. Bobrow

417 *An Extraordinary Journey: The Memoirs of a Physical Medium* by Stewart Alexander
Zofia Weaver

422 *Science Fictions: How Fraud, Bias, Negligence, and Hype Undermine the Search for Truth* by Stuart Ritchie
Henry H. Bauer

433 *Mystery Cats of the World Revisited: Blue Tigers, King Cheetahs, Black Cougars, Spotted Lions, and More* by Karl P. N. Shuker
George M. Eberhart

Journal of Scientific Exploration
Volume 35, Issue 2
ISSN 0892-3310 (836)
journalofscientificexploration.org