International Journal of Transpersonal Studies

Volume 42 | Issue 1 Article 6

2023

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Adam J. Rock
School of Psychology, University of New England, Australia

James Houran
Laboratory for Statistics and Computation, ISLA—Instituto Politécnico de Gestão e Tecnologia, Porto, Portugal

Patrizio E. Tressoldi
Science of Consciousness Research Group, Studium Patavinum, Università di Padova, Italy

Brian Laythe
Institute for the Study of Religious and Anomalous Experience (I.S.R.A.E.), Charlestown, Indiana, USA

Recommended Citation

Rock, A. J., Houran, J., Tressoldi, P. E., & Laythe, B. (2023). Is biological death final? Recomputing the Drake-S equation for postmortem survival of consciousness. *International Journal of Transpersonal Studies, 42* (1). https://doi.org/10.24972/ijts.2023.42.1.9

Is Biological Death Final? Recomputing the *Drake-S* Equation for Postmortem Survival of Consciousness

Adam J. Rock,[1] James Houran,[2, 3] Patrizio E. Tressoldi,[4] Brian Laythe[5]

1. School of Psychology, University of New England, Australia
2. Laboratory for Statistics and Computation, ISLA—Instituto Politécnico de Gestão e Tecnologia, Porto, Portugal
3. Integrated Knowledge Systems, Dallas, Texas, USA
4. Science of Consciousness Research Group, Studium Patavinum, Università di Padova, Italy
5. Institute for the Study of Religious and Anomalous Experience (I.S.R.A.E.), Charlestown, Indiana, USA

This participatory team science project extended Laythe and Houran's (2022) prior application of a famous probabilistic argument known as the "Drake equation" to the question of postmortem survival. Specifically, we evaluated effect sizes from peer-reviewed, empirical studies to determine the maximum average percentage effect that ostensibly supports (i.e., "anomalous effects") or refutes (i.e., "known confounds") the survival hypothesis. But unlike the earlier application, this research included a study-specific estimate of the hypothesized variable of "living agent psi" via a new meta-analysis of empirical studies (N = 17) with exceptional subjects vs participants from the general population. Our updated analysis found that putative psi was a meaningful variable, although it along with other known confounds still did not account for 30.3% of survival-related phenomena that appear to attest directly to human consciousness continuing after physical (biological) death. Thus, the popular conventional variables that we measured here are seemingly insufficient to account for a sizable portion of the purported empirical data that has been interpreted as evidence of survival. Our conclusion is nonetheless tempered by several assumptions and limitations of our speculative exercise, which ultimately does not affirm the existence of an 'afterlife' but rather highlights the need for measurements with greater precision and/ or a more comprehensive set of quantifiable variables. Therefore, we discuss how our probabilistic approach provides important heuristics to guide future research in this highly controversial domain that touches both parapsychology and transpersonal psychology.

Keywords: *anomalous experiences, biological death, consciousness, empiricism, probability, psi*

Biomedical authorities regularly debate the nature and definitions of clinical, brain, and biological death (e.g., Burkle et al., 2014; Goila & Pawar, 2009; Miller et al., 2021; Sarbey, 2016; Tomasini, 2017; Trueba, 2007; Youngner & Arnold, 2001). Cessation of heartbeat and respiration denote clinical death, but the concepts of brain and biological death involve the complete loss of neurological functions. Greer et al. (2020, p. 1078) specifically proposed eight diagnostic criteria in this context: (1) no evidence of arousal or awareness to maximal external stimulation, including noxious visual, auditory, and tactile stimulation; (2) pupils are fixed in a midsize or dilated position and are nonreactive to light; (3) corneal, oculocephalic, and oculovestibular reflexes are absent; (4) there is no facial movement to noxious stimulation; (5) the gag reflex is absent to bilateral posterior pharyngeal stimulation; (6) the cough reflex is absent to deep tracheal suctioning; (7) no brain-mediated motor response to noxious stimulation of the limbs; and (8) spontaneous respirations are not observed.

Accordingly, brain or biological death would seem to permanently extinguish an individual's consciousness, i.e., a state comprising the collective features of *identity* (personality), *perception* (awareness of stimuli), *sentience* (awareness of feelings/ sensations), and *cognition* (understanding

https://doi.org/10.24972/ijts.2023.42.1.9

perceptual, sensorial, or emotional stimuli) (Laythe & Houran, 2022). But other scientists have documented several categories of anomalies that potentially undermine the assumption that consciousness is inherent to, or constrained by, the activity of a living brain or other physiological functions. Key examples include near-death experiences (NDEs), cases of the reincarnation type, after-death communications, apparitions and haunt-related phenomena, and mental mediumship (or channeling) (for definitions and overviews, see e.g., Cardeña et al., 2014; Irwin & Watt, 2007; Rock, 2014; Storm & Thalbourne, 2006). These and other parapsychological-like occurrences or capabilities have long been recognized as relevant to transpersonal psychology (Friedman et al., 2021; MacDonald & Friedman, 2012; Rock et al., 2013; Tart, 2002, 2004), which integrates the spiritual and transcendent aspects of the human experience with the framework of modern psychology and broader consciousness studies. However, the ontological reality—and hence evidential value—of such survival-related phenomena has been sharply criticized on methodological and conceptual grounds (Augustine, 2022a, 2022b; Martin & Augustine, 2015; Tressoldi et al., 2022).

Rather than recycle the common rhetorical or ideological arguments *for* and *against* the survival hypothesis, Laythe and Houran (2022) instead forged an adversarial collaboration to calculate a net probability for the possibility of postmortem survival by drawing on Frank Drake's famed 1961 Drake Equation thought experiment that estimated the number of intelligent civilizations potentially within the Milky Way galaxy (Billings, 2013; Shostak, 2019). Some science commentators have faulted the original Drake equation for its imprecise estimates of speculative variables (e.g., Shermer, 2002; Siegel, 2018), whereas its central approach of probabilistic argumentation has been favored by other authors in peer-reviewed research (e.g., Burchell, 2006; Frank & Sullivan, 2016). Despite its inherent limitations, Shostak (2019) argued that "We should appreciate the Drake Equation for its usefulness, not for its possible shortcomings. After all, a map is not a destination. But it can help you get there" (para. 20).

Likewise, Laythe and Houran (2022) used hundreds of published studies sourced via scoping reviews of the empirical literature to evaluate the maximum average percentage effect that seemingly supports (i.e., *anomalous effects* or AEs, as noted above) or refutes (i.e., *known confounds* or KCs) the survival hypothesis. Their "big-picture" computation found that the known confounds of expectancy-suggestion effects, environmental factors, fraud, measurement error, mental illness, and susceptibility to perceptual aberrations or cognitive misinterpretations in healthy individuals" (p. 137) did not account for 38.6% of reported anomalous "effects" that arguably attest to some type of an "afterlife." In more specific and technical terms, Laythe and Houran's error terms for the KCs and AEs represented simple averages of individual research findings that they converted either to *percentage* (in the case of AEs) or average *variance* (in the case of KCs). Subsequent analysis found that the *aggregated* explanatory power of the conventional explanations subsequently failed to resolve the *collective* frequency rates of ostensible survival-related experiences or cognitions. This result arguably suggests that popular conventional explanations are insufficient at this time to describe a sizable portion of the spontaneous case evidence offered for postmortem survival.

The Living Agent Psi (LAP) Hypothesis for Survival-Related Phenomena

From a frontier science perspective, a major confound not considered by Laythe and Houran's (2022) preliminary *Drake-S* (survival) equation is LAP. Psi denotes the mechanisms underlying the hypothesized concept of extrasensory perception (ESP), that is, anomalous interactions between people or involving an individual and certain stimuli or objects in the environment (Irwin & Watt, 2007). This definition encompasses three distinct types of experiences or cognitions, namely: (a) *mind-matter interaction* (i.e., psychokinesis or PK), (b) *anomalous mental communication* (i.e., telepathy), and (c) *anomalous anticipation* (e.g., precognition or presentience) *or reception of information* (e.g., clairvoyance or remote-viewing). Moreover, some researchers reject survival-related interpretations of anomalous experiences in favor of so-called "super-ESP" (or super-psi). This idea asserts that psi abilities in living people have no known limits

and will therefore super-ESP will always be more parsimonious than explanations that posit an afterlife (cf. Thalbourne, 2003, p. 121).

However, Braude (2003, 2014) argued for replacing the term super-ESP or -psi with the seemingly more accurate and neutral term "living agent psi." We refer readers to LeBel et al. (2022, Appendix) for a discussion of the conceptual issues in this debate. But the fundamental epistemological issue nonetheless associated with any type of survival research is that:

> If a piece of putative evidence for survival is to be of use, it must be verifiable—we must be able to check by consulting records or surviving friends that the information given by the ostensible communicator is correct. But if the sources for checking are extant, they might in theory be telepathically or clairvoyantly accessible to the medium or percipient. Since we do not know the limits of ESP, we can never say for certain that ESP of the extraordinary extent that would be necessary . . . is actually impossible (Gauld, 1982, p. 15).

It can thus be argued that the super-ESP hypothesis is not empirically testable, because it assumes a virtually unlimited capacity that cannot be falsified by scientific methods (Martinez-Taboas, 1983). But the same problem of falsification perhaps also applies to any claimed form of psi (Reber & Alcock, 2020). However, LeBel et al. (2022) asserted that a limited capacity LAP hypothesis is eminently testable since this view merely refers to psi generated consciously or unconsciously by living percipients rather than an "unlimited-capacity" psi.

The Present Study

Following the above, we aimed to recalculate Laythe and Houran's (2022) *Drake-S* Equation for postmortem survival while addressing the alleged confound of LAP. Estimating the boundaries of putative psi is a thorny proposition. However, we sought to develop an aggregated effect size for LAP using two indices that follow Tart's (1976, pp. vii-viii) analogy of *lightning strikes* versus *weak static effects* for parapsychological phenomena. Lightning strikes refer here to measures of psi from dramatic spontaneous cases and research with exceptional subjects, whereas weak static effects represent laboratory experiments of psi with "normal" (i.e., non-exceptional) individuals. Each category of data has its own strengths and weaknesses.

Of course, psi is a hypothetical and controversial construct (Etzold, 2006; French & Stone, 2014; Rabeyron, 2020) and thus LAP is perhaps an even less tenable premise to account for the various survival-related phenomena (Sudduth, 2009). We nonetheless adopt Schooler et al.'s (2018, p. 63) perspective of "entertaining without endorsing" for the sake of the present exercise. Thus, our analysis of LAP relative to the survival hypothesis is conducted from an impartial stance that continues previous adversarial or cross-disciplinary collaborations in psi research (e.g., Honorton & Hyman, 1986; Kennedy, 2004; Laythe et al., 2021; Laythe & Houran, 2022; LeBel et al., 2022; Parnia et al., 2022; Schlitz et al., 2006; Tressoldi et al., 2022). At the same time, we emphasize that our proposed analysis does not directly test the survival hypothesis. It merely serves as a tentative effort at using a novel metric to explore a presumably intractable question in the hope that it might spark thinking that could lead to more substantive lines of future research.

Method

We sourced studies on the effect sizes for these two categories of evidence via systematic reviews to identify, assess, and synthesize important literature. We specifically targeted research consisting of (a) peer-reviewed meta-analyses of experimental psi outcomes in the general population, and (b) peer-reviewed experiments with so-called exceptional subjects. Thus, this approach was intended to capture data with moderate-to-high levels of quality per the traditional hierarchy of scientific evidence (Tressoldi et al., 2022). Several critiques of meta-analysis and its limitations have been published (Berk & Freedman, 2003; Ioannidis, 2016; Root, 2003; Sohn, 1995, 1996, 1997), especially in the context of parapsychological studies (e.g., Hyman, 2010; Stenger, 2007). Yet such results are arguably the only foundational material to compute a data-driven upper (or exclusion) limit for LAP.

We caution that our exercise makes two working assumptions about the "source of psi" problem, which references whether certain anomalous phenomena are best interpreted as attributable to "deceased agents" or "living agents" (for discussions, see e.g., Braude, 2014; Sudduth, 2016; LeBel et al., 2022: Appendix). In particular, we contend that (a) the death-related AEs from Laythe and Houran's (2022) original *Drake-S* Equation often involve seemingly veridical contents or expressions of an independent personality that *prima facie* suggest discarnate consciousness, whereas (b) from the standpoint of parsimony, we deem the laboratory-based studies of putative psi used in this paper more likely to represent the limited capacities of living people, as these experimental outcomes are consistently related to various individual differences or mental states of the research participants (e.g., paranormal belief or transliminality, cf. Thalbourne & Houran, 2003; Thalbourne & Storm, 2012; Tressoldi & Storm, 2021), and thus the limited capacity interpretation of LAP in these circumstances avoids postulating the idea of super-psi (i.e., psi with no known limits), or the existence of entities that are ontologically distinct from embodied minds (i.e., discarnates) and, therefore, an "afterlife."

"Weak Static" Measures of Putative Psi

Fortuitously for this project, Tressoldi and Storm (2021) already conducted a review of 11 meta-analytic studies of anomalous cognition conducted between 1989 and 2021 in order to find moderators associated with greater effect sizes across six different states of consciousness. They unequivocally demonstrate that altered or non-normal states of consciousness, such as dreaming or sensory deprivation settings (so-called Ganzfeld effects, i.e., a "whole-field" that consists of an unstructured, uniform space covering one's entire visual field), along with free-response techniques, or neurophysiological dependent factors, seem to be capable of enhancing anomalous cognition to a large degree, i.e., effect sizes (Cohen's *d*) ranging from .02 to .28 or more (cf. their Table 1, p. 61). We should mention that these coefficients are generally lower than the median effect sizes reported in non-preregistered studies across the social sciences (Schäfer & Schwarz, 2019).

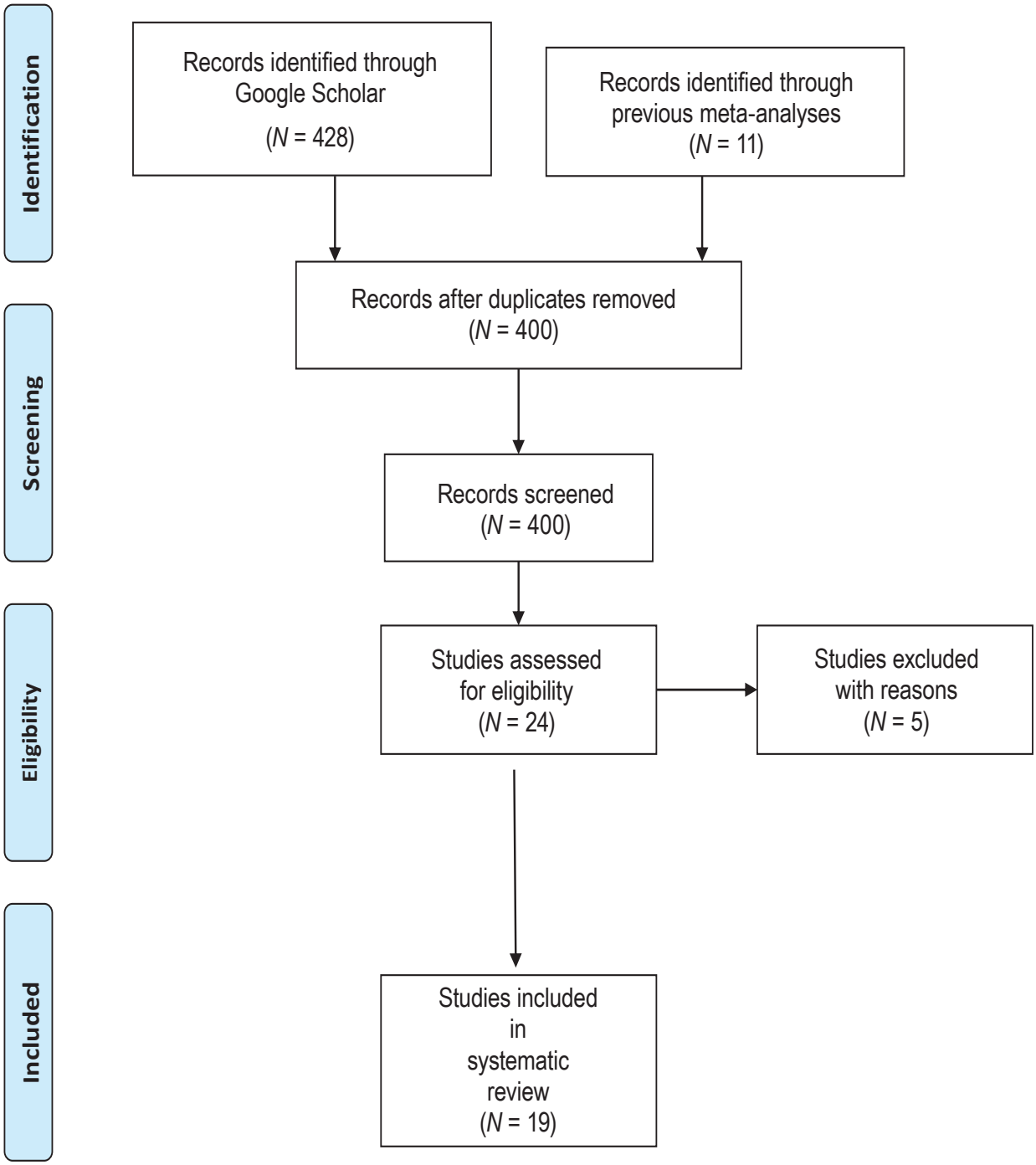
"Lightning Strike" Measures of Putative Psi

The available evidence suggests that most cases of reportedly "spontaneous psi" are not actually psi (Kennedy, 2000), so the magnitude of anomalous cognition cannot be reliably assessed from case collections or survey research on "environmental psi in the living world" (for important examples along these lines, see: Gurney et al., 1886; Haraldsson, 1985; Haraldsson et al., 1977; McClenon, 2012; Palmer, 1979: Ross & Joshi, 1992; Sidgwick et al., 1894). Therefore, our estimate of "lightning strike" psi derives from peer-reviewed research with "exceptional subjects." This term refers to self-described psychics, sensitives, or intuitives who produce above-chance results under controlled testing conditions.

Following the APA guidelines for meta-analysis and systematic reviews (Appelbaum et al., 2018; Page et al., 2021), we searched for pertinent studies with exceptional subjects via the Google Scholar database, which is considered more inclusive than other scientific databases such as PubMed or Scopus, and specifically using the keywords "selected participants *or* gifted participants *or* exceptional participants *and* ESP *or* parapsychology." Furthermore, we searched for studies related to selected participants in the references of the retrieved studies.

We excluded studies with insufficient details about the experimental design and incomplete data for the effect size estimation, as well as studies or experiments with null results. Figure 1 shows that nineteen studies were included in this review, and these are denoted with asterisks in the References. We estimated effect size using the binomial test[1] taking the number of trials, the number of correct hits and the chance probability as raw scores using an online algorithm (available at http://vassarstats.net/binomialX.html). Standard error was estimated dividing the standard deviation with the square root of the number of trials. We compared the results obtained by the selected participants with those obtained by the general population using the available meta-analyses. Table 1 presents the effect sizes of each of the retrieved studies and the comparison with those observed in the general population, divided by the different tasks.

Figure 1. *PRISMA Flow Diagram for Search of Exceptional Subjects in Non-Ordinary Perception and Mind-Matter Interaction*



Controlled Studies of Mental Mediumship

A class of exceptional subjects that deserves special consideration in our analysis is "mental mediums." Gauld (1982) described mental mediumship as communication with deceased persons that is experienced "through interior vision or hearing, or through the spirits taking over and controlling their bodies or parts thereof, especially… the parts required for speech and writing" (p. 4). Several authors give a parapsychological

Table 1.

Effect Sizes of Putative Psi from Representative Studies on "Exceptional Subjects"

Free Response Clairvoyance - Precognition Remote Viewing							
Exceptional Subjects					***General Population***		
Source	**Participants**	**Trials**	**ES**	**SE**	**Source**	**ES**	**95%CIs**
Claudewitz et al. (2011)	Single case	50	.30	.30	Storm & Tressoldi (2020)	.027	.001–.07
Holt, N. (2013)	15 artists	15	.27	.43			
May et al. (1989)	Experts–SRI International	196	.38	.071			
	Experts–Science Applications International Corporation (SAIC)	445	.23	.047			
Musso & Granero (1973)	Single case	90	.49	.37			
Riess (1937)	Single case	2100	1.25	.40			
Müller et al. (2019)	15	48	.56	.50			
Müller & Wittmann (2021)	5	100	.49	.50			
Katz et al. (2021)	12 (self-rating)	360	.76	.43			
Overall Meta-Analysis			**.41**	**.28–.53**			
Free Response Clairvoyance – Precognition in a Ganzfeld Environment							
Exceptional Subjects					***General Population***		
Source	**Participants**	**Trials**	**ES**	**SE**	**Source**	**ES**	**95%CIs**
Schlitz & Honorton (1992)	20	20	.52	.43	Tressoldi & Storm (2021)	.047	.003–.107
Tressoldi & Storm (2021)	43 studies–selected participants		.15	.03			
Forced-Choice Clairvoyance – Precognition in Hypnosis							
Exceptional Subjects					***General Population***		
Source	**Participants**	**Trials**	**ES**	**SE**	**Source**	**ES**	**95%CIs**
Rýzl & Rýzlová (1962)	Single case–series 1	2000	.14	.50	Stanford & Stein (1994)	.048	.038–.058
	series 2	2000	.26	.50			
Forced-Choice Clairvoyance – Precognition in a Normal State of Consciousness							
Exceptional Subjects					***General Population***		
Source	**Participants**	**Trials**	**ES**	**SE**	**Source**	**ES**	**95%CIs**
Child & Kelly (1973)	Single case	9000	.03	.40	Storm et al. (2012)	.014	.006–.022
Honorton (1987)	Single case – precognitive task	490	.12	.43			
Honorton & Ferrari (1989)	25 studies - selected partic		.051	.075			
Kanthamani & Kelly (1974)	Single case -series 1	260	.68	.14			
	series 2	208	1.1	.14			
	series 3	364	.35	.14			
Ryzl et al. (1965)	Single case	2000	.16	.50			
Steilberg (1971)	Single case	4075	.10	.40			
Overall meta-analysis			**.39**	**.05–.74**			
Micro PK in a Normal State of Consciousness							
Exceptional Subjects					***General Population***		
Source	**Participants**	**Trials**	**ES**	**SE**	**Source**	**ES**	**95%CIs**
Hilton et al. (1943)	Two single cases–dice	4840	.05	.50	Radin & Ferrari (1991)	.012	.0114–.0126
Varvoglis & Bancel (2016)	Two single cases–RNG	187000	.015	0.00005	Bösch et al. (2006)	.00007	.000056–.000084

Note: ES = standardized effect size; SE = standard error; CI = confidence intervals

interpretation to these perceptions, as mediums sometime provide ostensibly specific or veridical information under blinded conditions and across independent studies and investigators (e.g., Beischel et al., 2015; Jensen & Cardeña, 2009; Kelly & Arcangel, 2011; Roy & Robertson, 2004). Table 2 shows that the literature contains two meta-analyses of peer-reviewed empirical studies on mental mediumship (Rock et al., 2021; Sarraf et al., 2021). Note that the Sarraf et al. (2021) study specifically included "Windbridge Certified Research Mediums," that is, those studied by the Windbridge Research Center and reportedly found to perform accurate readings consistently under "beyond double-blind" conditions. The two meta-analytic studies reported overall effect sizes for mental mediumship that are reasonably consistent.

The Drake-S Equation

Laythe and Houran (2022, p. 145) presented their original simplified *Drake-S* formula as:

$$P_P = (P_R * [1- \sum E_N]) \quad (1.1)$$

Where P_P is the purified probability of a paranormal experience (P_P); P_R is the raw probabilities of paranormal experience where error factors are subsequently removed by subtracting all error covariance from one and multiplying, which provides the remaining percentage of P_R theoretically pure from the covariance of the proposed error effects (P_P).

E_N represents six broad factors which serve as alternative explanations for paranormal experiences:

Table 2. *Summary of Meta-Analyses of Studies on Mental Mediumship*

Mediumship Study	Studies	*ES*	95% CIs
Rock et al. (2021)	8	.22[a]	-.02, .44
Sarraf et al. (2021)	18	.18[b]	.12, .25

Note: *ES* = standard effect size;
CIs = confidence intervals
[a] $ES_r = \sqrt{[\chi^2 / N_{trials}]}$
[b] Proportion Index =
PI^2(1-PI)^2/(Raw Percentage*(1-Raw Percentage))

E_M = Measurement Error
E_E = General Expectancy Effects (Contagion, Memory, Persuasion)
E_V = Environmental Effects
E_F = Fraud
E_{MI} = Mental Illness (Hallucination)
E_S = Susceptibility to Perceptual Aberrations

The expansion of $\sum E_N$ is the covariation represented by the above six factors, specifically ignoring covariation *between* these six factors and treating each as an independent and additive reduction of the P_R raw paranormal probability reported by subjects. Thus,

$$P_P = (P_R * [1- \sum E_N])$$

is expanded within the sum error term as:

$$\sum E_N = (E_M + E_E + E_{V+} E_{F+} E_{MI} + E_S) \quad (1.2)$$

From the preceding, we must add LAP to the above error terms noting that although a parapsychological concept, psi in this context serves as a *prima facie* confound to the idea of survival evidence. As such, we augmented the above EN model with the new error term of "ELAP" or the aggregated variance that could theoretically be attributable to LAP as estimated from laboratory psi effects with exceptional subjects. In this way, we can subtract its variance along with previously established error terms to gain an updated estimate of unexplained variance across the collective set of ostensible survival-related phenomena, i.e., NDEs, cases of the reincarnation type, after-death communications, apparitions and haunt-related phenomena, and mental mediumship.

Results

Below we separately report the outcomes of two related analyses: (a) our proposed upper-limit estimate for LAP based on a meta-analysis of the studies from our systematic review (cf. Table 1), and subsequently (b) the recomputed *Drake-S* Equation that uses this new estimate of putative LAP as another known confound to a survivalist interpretation of certain anomalous experiences.

Computing an Upper (or Exclusion) Limit for LAP

We estimated the effect size upper 95% confidence interval of psi performance by meta-analyzing all the data related to the selected participants presented in Table 1, plus the "Windbridge-certified" mediums data reported in Sarraf et al.'s (2021) meta-analysis but rejecting studies related to micro-PK (i.e., small-scale psychokinesis) in a normal state of consciousness. Our reasoning was that apparent psychokinetic ability represents mind-matter interaction versus perception of information at a distance.

The resultant upper 95% confidence interval effect size estimated with 5,000 bootstrapped samples was .60 (*SE* = .07), which represents an upper medium-sized *d* value based on Cohen's (1988) suggested benchmarks. In fact, this outcome approaches the median effect sizes reported in non-preregistered studies across the social sciences (Schäfer & Schwarz, 2019). Applying this coefficient with our overall Cohen's *d* and converting it to variance ($R^{2\ est}$), we get an estimate equaling .083 (Cohen's *d* = .60, or a correlation coefficient of R^{est} = .287). Thus, as an upper bound estimate of LAP, approximately 8.3% of the variance of ostensible survival-related phenomena in theory could be mathematically attributed to LAP.

Recalculating the Drake-S Equation

We can now add the ELAP metric above to Laythe and Houran's (2022) previous estimates of the other KC's, i.e., (a) *expectancy-suggestion* ($R^{2\ est.}$ = .097), (b) *environmental variables* ($R^{2\ est.}$ = .077), (c) *fraud* ($R^{2\ est.}$ = .20), (d) *measurement error* ($R^{2\ est.}$ = .067), (e) hallucination-inducing *mental illness* ($R^{2\ est.}$ = .039), and (f) *psychological susceptibility factors* that can cause perceptual aberrations or cognitive errors ($R^{2\ est.}$ = .134). Recall that these estimates represent simple averages of individual research findings from scoping reviews of the empirical literature that were converted to average variance. These aggregate factors add (without accounting for covariance between factors) to 61.4%. Including our new ELAP metric (i.e., 8.3%), the approximate variance accounted for by all the KCs and putative "living agent psi" amounts to 69.7%. This leaves 30.3% of ostensible survival-related phenomena presumably left unexplained by the confounding variables operationalized and measured in our exercise.

Methodological Considerations and Limitations

Our results fine-tune Laythe and Houran's (2022) original probability estimate for postmortem survival of consciousness by including an index for the ostensible confound of LAP, However, the updated metric of 30.3% (vs. the initial 38.6% estimate) does not change the previous conclusion that the effect sizes of the identified confounds do not account for a sizable portion of variance in survival-related (anomalous) phenomena. That said, the outcomes of any analysis are no better than the measurements used. Increasingly more appropriate variables or precise measurements will surely follow from new knowledge or technologies. Thus, studies that add or modify the variables or estimates in this iteration of the *Drake-S* Equation could shift our

Table 3. *Comparison of Variance Explained by Known Confounds and Living Agent Psi Compared to Purified Prevalence Rates of Survival-Related Phenomena (cf. Laythe & Houran, 2022).*

Conventional Explanations Variance Explained	***%***	***Anomalous Phenomena-Population Prevalence***	***%***	***Purified %***
Mental Illness	0.039	Reincarnation	0.002	0.001
Measurement Error	0.067	Mediumship	0.020	0.006
Environmental Variables	0.077	Near-Death Experience	0.094	0.028
'Living Agent Psi'	0.083	Hauntings/Poltergeists	0.200	0.060
Expectancy-Suggestion	0.097	Veridical Anomalous Experience	0.260	0.078
Psychological Susceptibility	0.134	General Paranormal Experience	0.415	0.125
Fraud	0.200			
Variance Explained	**0.697**	*Cumulative (within category) Purified Percentage*		**0.298**

calculus in the future. We enthusiastically encourage such new and critical research, and notably along interdisciplinary lines that mesh parapsychology, transpersonal psychology, and the biomedical sciences (see e.g., MacDonald & Friedman, 2012).

On this latter point, Table 3 indicates that particular *Veridical Anomalous Experiences* (% = .26, purified % = .078) (see e.g., Elsaesser et al., 2020) and *Haunt-Poltergeist Episodes* (% = .200, purified % = .060) (see e.g., Betty, 1984) are potentially the AEs with the greatest evidential value to the survival hypothesis simply by their sheer prevalence, whereas the KCs of *Psychological Susceptibility* (R^2 = .134) and *Fraud* (R^2 = .20) are presently among the most powerful counter-explanations that deserve more research to understand their mechanisms and regulators. Indeed, we certainly agree with Shostak (2019) that the Drake Equation approach serves as much as a research roadmap as a mere method or outcome (for a discussion, see Laythe & Houran, 2022, p. 148). Our findings further imply that dogmatic "pro or con" statements about the survival questions are misguided and unhelpful. We contend that neither ideological stance can sufficiently contextualize all the available empirical information. At the very least, our exercise provides intriguing results that underscore the limitations of current measurements of KCs and AEs that define this iteration of the *Drake-S* Equation.

Finally, we recognize that our ELAP metric is unavoidably speculative and imprecise. We therefore recommend that future studies should strive to corroborate or refute our exclusion limit for LAP. While our results do not support the idea of "unlimited or unbounded" psi, we certainly could have underestimated its maximum capability. Indeed, Tart's (1976) description of "weak static" versus "lightning strike" psi seems quite appropriate, as "exceptional subjects" do show stronger effect sizes than laboratory psi studies with participants from the general population (cf. Table 1). But researchers have long discussed multiple constraints to positive psi outcomes that are often described as "Trickster" effects (see e.g., Kennedy, 2003). We are not fully convinced by such arguments for evasive or unsustainable psi but instead emphasize methodological challenges with controlled research in this domain, e.g., *attitude—experimenter effects* (Thalbourne & Storm, 2012); (b) *poor environmental conditions for successful testing* (Roney-Dougal et al., 2013); (c) *use of procedures or experimental tasks that are misaligned to the skill levels of research participants* (Lange & Houran, 2013), and (d) *measurement error* (Evans et al., 2019). We further note that measurement and replication issues are not unique to parapsychology but also stymie much of the social sciences (Earp & Trafimow, 2015; Kornbrot et al., 2018; Tressoldi, 2012).

Thus, our estimate of LAP was inevitably inferred from maverick studies that reported only the currently measured limits of putative psi. Accordingly, the *Drake-S* Equation might produce different results if future studies more precisely clarify the upper limits of LAP. The challenge is how best to study and learn from the rarer "lightning strike" forms of psi but using sensible controls inherent to "weak static" laboratory testing. We have no immediate solution, but some researchers have recommended that new research could focus on individuals who are exceptionally "lucky" in daily life, i.e., individuals who report that seemingly chance events consistently tend to work out in their favor (e.g., Luke et al. 2008). It might be that this subset of presumably psi-conducive people (along with "exceptional subjects" in psi research) will report more survival-related phenomena, which could help to corroborate or refine the LAP hypothesis.

Discussion

Despite our varied academic backgrounds and different interpretations of the empirical literature in this domain, the present team concurs that the question of postmortem survival of consciousness is:

- Important both to biomedical and transpersonal theory and practice (cf. MacDonald & Friedman, 2012), as opposed to a topic constrained to scientific parapsychology or pseudoscientific thinking.
- Amenable to empirical testing per current scientific protocols, i.e., specific conceptual viewpoints on the topic can generate falsifiable hypotheses per Popper's (1959) paradigm.

- A research area that must be grounded in both the highest level and quality of scientific evidence to compel the broader academic community (see e.g., LeBel et al., 2022).

Speaking to these points, our evaluation and outcomes arguably challenge—at the very least—the current conceptualizations of brain or biological death as "conditions or states" that permanently extinguish one's consciousness, i.e., the concurrence of personal identity, perception, sentience, and cognition. More specifically, the effect sizes of the major KCs (i.e., mental illness, expectancy/suggestion, environmental effects, fraud, measurement error, and perceptual aberrations or errors), including the newly added variable of "living agent psi" are neither individually nor collectively robust to resolve the collective prevalence rates of survival-related (anomalous) phenomena.

It is curious that our exclusion limit of LAP was moderately powerful in the amount of variance it explained — even outperforming the KCs of mental illness, measurement error, and environmental factors in the current formula (cf. Laythe & Houran, 2022). This might surprise some readers given that psi is not a scientifically established phenomenon, and thus tests or measurements of this putative construct have unknown reliabilities and validities. Moreover, empirical studies on psi have been criticized on conceptual, methodological, or statistical grounds (e.g., Houran et al., 2018; Hyman, 1995, 2010; Rabeyron, 2020; Reber & Alcock, 2020; Wagenmakers et al., 2011) — and these arguments have been particularly levied at survival-related research (e.g., Augustine, 2022a, 2022b; Bastos et al., 2015; O'Keeffe & Wiseman, 2005; Martin & Augustine, 2015).

Some authors therefore characterize the claimed evidence for psi as an appeal to ignorance (Houran et al., 2017b, 2018). Equally, our findings neither directly support the survival hypothesis nor clarify any philosophical descriptions about the hypothetical nature of any "afterlife" state. At most, our probability estimate implies the presence of an anomaly (or set of anomalies) in need of a viable explanation that is seemingly lacking in presently understood scientific principles. We speculate that the anomalous experiences considered here might therefore involve unexpected *biological flexibilities* (e.g., Vrselja et al., 2019) or expanded *perceptual capabilities* (e.g., Houran et al., 2017a) in the context of death and dying. Still, the role of ostensibly anomalous factors in survival-related narratives is highly intriguing but remains to be determined.

But at face value, our revised *Drake-S* formula is a *ceteris paribus* clause that serves as a "all things being equal" heuristic to describe the rate of occurrence of survival-related phenomena, or within each case of said phenomena. Applied to the former, the equation implies that "*For any given set of purported anomalous phenomena, six out of ten cases will be due to known confounds, one out of ten could represent living agent psi, and three out of ten cases would thus represent purported evidence of discarnate agency.*" Applied to a case-to-case basis, the formula would state that "*For any given particular paranormal case, 60% of the phenomena can be attributed to conventional factors, 10% to living agent psi, and 30% to potential discarnate agency.*" Both statements have many assumptions, but we might note that for both within and between applications we are dealing with a hypothesized percentage that is testable, and either or both could apply.

Our study likewise has several limitations that future research could address. For instance, the present design although exploratory was not pre-registered as otherwise recommended by many mainstream social scientists (e.g., Schäfer & Schwarz, 2019) and parapsychologists (e.g., Watt & Kennedy, 2015). Nosek et al. (2018) similarly argued that "preregistration improves the interpretability and credibility of research findings" (p. 2605) across all of the sciences, but others question the underlying reasons for this widely adopted conclusion (e.g., Pham & Oh, 2020; Rubin, 2020). We also note that the prevalence rates of the five types of survival-related phenomena and the effect sizes of the known confounds used in our analysis derived from scoping versus systematic reviews (cf. Laythe & Houran, 2022). As a result, we potentially overlooked some key information that might have altered our results or conclusions. Our aggregated approach could also be criticized for not examining

the quality of evidence or external validity of the known confounds relative to each anomalous effect for a more precise evaluation (see e.g., Tressoldi et al., 2022).

The *Drake-S* Equation presented here makes no such distinctions and instead treats the AEs and KCs collectively as two groups. Indeed, some confounds might be more feasible or applicable than others when assessed as explanations for certain survival-related reports. It is also possible that our general categories of KCs underestimate, if not ignore, the explanatory power of specific or nuanced psychological or neurological models for certain AEs (cf. Martin & Augustine, 2015). For instance, "mental illness" or "vulnerability to perceptual aberrations or errors" may not adequately represent the evidence that higher concentrations of carbon dioxide and serum levels of potassium are involved in NDEs (Klemenc-Ketis et al., 2010). Similarly, the notion that impressive demonstrations of alleged physical or mental mediumship are accomplished using closely-guarded conjuring techniques (e.g., Tompkins, 2019) is perhaps not strictly captured by our statistics on "fraud."

For the benefit of readers, however, we should also emphasize both in the current work and the initial formulation of the *Drake-S* Equation (Laythe & Houran, 2022) that our mathematics intentionally did *not* account for co-variation between the error factors presented so as to yield a final probability estimate that is biased in favor of skepticism. Barring suppression effects from dichotomous variables not measured here, covariation between, say, environmental effects and expectancy-suggestion effects (that relate to each other, see e.g., Freedman et al., 1980; Johnson et al., 2011; Rende et al., 2005). are likely to reduce the KC variance rather than increase it. Similar empirical arguments can be made for most of the conventional explanations. As such, further refinement of this formula in terms of accounting for covariance between the KCs will very likely reduce the percentage of anomalous phenomena explained by conventional variables.

Taken altogether, research on the various facets, definitions, and experiences related to death are pertinent not only to biomedical theory and practice but also more broadly to the field of consciousness studies, which includes parapsychology and transpersonal psychology. Our latest calculation of the *Drake-S* Equation does not prove the ontological existence of postmortem survival of consciousness, but it does serve as an intellectual exercise to help (a) bring empirical balance and rigor to assessing the statistical power of competing explanations for survival-related phenomena, and (b) identify those categories of anomalies with the most potential for refining or refuting current models of clinical, brain, and biological death, and how these constructs inform the hard problem of consciousness. Namely, this is the issue of how matter like the human brain or any biological system is capable of subjective and transcendent experiences, i.e., phenomenal consciousness or mental states and events with phenomenal qualities or qualia (Chalmers, 1995; Goff, 2017; Kleiner, 2020). To be sure, we cannot answer the provocative question posed in our title, but the present findings arguably help to justify asking it in the first place.

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Author Credit Statement

Adam J. Rock: Conceptualization, Investigation, Writing – Original draft preparation, Data curation, Formal analysis, Review, and Editing. James Houran: Conceptualization, Project Administration, Investigation, Writing – Original draft preparation, Review, and Editing. Patrizio E. Tressoldi: Investigation, Data curation, Formal analysis, Writing – Original draft preparation, Review, and Editing. Brian Laythe: Investigation, Formal analysis, Writing – Original draft preparation, Review, and Editing.

Conflict of Interest Statement

This study was entirely self-funded, and the authors declare that there is no conflict there is no conflict of interest. The first author is on the editorial team of the IJTS, but the peer-review of this paper was handled independently.

About the Authors

Adam J. Rock, PhD (https://orcid.org/0000-0002-1430-3745), holds a doctoral degree in psychology

from Charles Sturt University, NSW, Australia. He currently serves as an Associate Professor of Psychology at the University of New England (Australia) and Research Editor for the *International Journal of Transpersonal Studies*. He is the author of over 100 professional publications and his primary research focus is the nature of consciousness.

James Houran, PhD (https://orcid.org/0000-0003-1725-582X), has a doctoral degree in psychology from the University of Adelaide (Australia). He serves as Research Director at Integrated Knowledge Systems (IKS) in the USA, Research Professor at the Instituto Politecnico de Gestao e Tecnologia (ISLA) in Portugal, editorial board member of the Journal of the Society for Psychical Research, special consultant for the Australian Journal of Parapsychology, and the Editor-in-Chief of the Journal of Scientific Exploration.

Brian Laythe, PhD (https://orcid.org/0000-0001-9081-2253), is the Founder/Director of the Institute for the Study of Religious and Anomalous Experience (I.S.R.A.E.) and Managing Partner of Iudicium, a forensic psychology consultancy. He obtained his Master's and PhD degrees in Experimental Psychology from the University of New Hampshire. Laythe is also the lead author of Ghosted! Exploring the Haunting Reality of Paranormal Encounters and co-host of the "Practical Parapsychology" podcast.

Patrizio E. Tressoldi, PhD (http://orcid.org/0000-0002-6404-0058), holds a doctoral degree in psychology from Padova University. He presently serves as a Senior Scientist at Studium Patavinum, Università di Padova, Italy and the Head of the Science of Consciousness Research Group. His main research interests relate to scientific evidence about the nature and characteristics of consciousness as a response to the existential question "Who am I really?"

About the Journal

The *International Journal of Transpersonal Studies* is a Scopus listed peer-reviewed academic journal, and the largest and most accessible scholarly periodical in the transpersonal field. IJTS has been in print since 1981, is published by Floraglades Foundation, sponsored in part by Attention Strategies Institute, and serves as the official publication of the International Transpersonal Association. The journal is available online at www.transpersonalstudies.org, and in print through www.lulu.com (search for IJTS).