Title

Observer-Participancy and the Collapse of Probable Futures:
A Human–AI Collaborative Theoretical Framework for Scale-Dependent Anomalous Cognition with Historical Application to the Edgar Cayce Corpus

Abstract

John Archibald Wheeler's observer-participancy model holds that the universe is not a pregiven structure passively observed but an informational construct constituted through measurement. His pregeometric framework—the proposed informational substrate beneath space-time—describes a domain in which classical constraints of locality and temporality are undefined. This paper proposes that consciousness operating at, or interfacing with, that substrate would exhibit the non-local, non-temporal properties reported in controlled parapsychological research, not as a violation of physics but as a consequence of it. The empirical context is provided by the umbrella meta-analysis of Tressoldi and Storm (2021) and the review by Cardeña (2018), both of which conclude that anomalous cognition is reproducible and strongest in altered states combined with free-response procedures.

The historical case examined is the trance readings of Edgar Cayce (1877–1945), treated as a case study whose formal properties—altered-state induction, apparent indifference to spatial and temporal separation, contemporaneous stenographic transcription, and cross-verifiable specific content—align with Wheeler's framework and with conditions empirically associated with anomalous cognition. The paper's central contribution is the participatory collapse model, which reframes Cayce's trance-state readings as participatory collapse of probable futures, structurally analogous to Wheeler's delayed-choice mechanism. This reframing generates six falsifiable predictions, including that accuracy scales inversely with the number of independent observers whose participancy shapes the target and decreases with temporal distance from the normal present. On this account, if trance-state anomalous cognition occurs, it represents an extension of a moving collapse front beyond its usual temporal

boundary—an engagement with probability distributions not yet resolved by ordinary observer-participancy.

Keywords: observer-participancy, anomalous cognition, quantum Darwinism, pregeometry, Edgar Cayce, participatory collapse, relational quantum mechanics

I. Empirical Foundation: Anomalous Cognition Under Controlled Conditions

Any theoretical framework that appeals to anomalous cognition must begin by asking whether there is a sufficiently robust empirical phenomenon to warrant serious explanatory work. Over the past three decades, the most informative answer to that question has come not from single experiments but from meta-analytic syntheses that aggregate results across laboratories, paradigms, and decades of research. The umbrella review by Tressoldi and Storm in the inaugural issue of this journal is the most comprehensive of these efforts to date (Tressoldi & Storm, 2021). Reviewing eleven meta-analyses conducted between 1989 and 2021 across six states of consciousness and multiple task types, they concluded that anomalous cognition "appears possible" and that its effects are systematically enhanced when participants are in altered states of consciousness and engaged in free-response procedures rather than forced-choice guessing (Tressoldi & Storm, 2021). Their analysis located the most reliable effects in paradigms that minimize sensory cues, emphasize internal imagery, and reduce cognitive load, with altered states such as ganzfeld, hypnosis, and meditative absorption producing stronger effect sizes than ordinary waking conditions (Tressoldi & Storm, 2021). Earlier free-response meta-analytic work by Storm, Tressoldi, and Di Risio (2010) likewise found above-chance performance, particularly in noise-reduction paradigms, foreshadowing the umbrella-level conclusions of Tressoldi and Storm (2021).

Cardeña's review in *American Psychologist* reached a parallel assessment from a broader vantage point (Cardeña, 2018). Surveying the controlled experimental literature on telepathy, clairvoyance, precognition, and presentiment, along with related work on survival and dissociation, he argued that the

cumulative evidence for anomalous cognition is comparable in strength to that for many accepted phenomena in psychology and can no longer be dismissed solely on methodological grounds (Cardeña, 2018). Instead, he suggested, the literature justifies a shift in emphasis from whether anomalous cognition occurs to how it might be understood within a broader framework of mind–brain–world relations (Cardeña, 2018). The present paper adopts that stance as its starting point: not that the evidence proves any particular mechanism, but that it establishes a nontrivial performance pattern under conditions designed to exclude ordinary sensory information.

The umbrella review and Cardeña's synthesis also clarify what the empirical literature does *not* yet provide. Effect sizes, though statistically robust in aggregate, are modest and highly sensitive to procedural details (Cardeña, 2018; Tressoldi & Storm, 2021). Outcomes vary across laboratories and epochs, with signs of publication bias in some domains (Cardeña, 2018; Tressoldi & Storm, 2021). Replication controversies around Bem's precognition experiments illustrate these tensions. Bem's original series reported effects at or beyond conventional "six sigma" thresholds (Bem, 2011), but subsequent Bayesian reanalyses and replication attempts by Wagenmakers and colleagues and by Ritchie, Wiseman, and French have highlighted how analytic flexibility and selective reporting can inflate apparent evidence (Ritchie et al., 2012; Wagenmakers et al., 2011). A broader meta-analysis of 90 experiments suggests that, across paradigms, small but non-zero precognition effects may be present, though subject to many of the same replication and publication-bias concerns (Bem et al., 2016). Utts's government-commissioned assessment of remote viewing data similarly concluded that some results could not be easily explained by chance or conventional cues, while emphasizing the need for tighter methodological control (Utts, 1996). Taken together, these critiques support a cautious reading: the best-controlled studies indicate that something beyond chance appears to be happening under specific conditions, but the phenomenon is fragile, context-dependent, and not yet characterized by the kind of

effect sizes that would force an immediate revision of physical theory (Cardeña, 2018; Bem et al., 2016; Ritchie et al., 2012; Tressoldi & Storm, 2021; Utts, 1996; Wagenmakers et al., 2011).

For present purposes, the empirical literature serves three roles. First, it justifies taking anomalous cognition seriously as an empirical target, particularly in altered states of consciousness combined with free-response procedures—the very conditions that will later be central to the historical case study examined here (Cardeña, 2018; Storm et al., 2010; Tressoldi & Storm, 2021). Second, it constrains any theoretical proposal: a viable framework must accommodate small but non-zero effects, state dependence, task dependence, and the apparent enhancement of performance in non-ordinary states (Cardeña, 2018; Tressoldi & Storm, 2021). Third, it sharpens the mechanistic question. The fact that altered states and reduced sensory input correlate with increased anomalous performance is consistent with multiple classes of explanation—ranging from subtle classical information leakage and expectancy effects to more radical proposals involving preconscious access to non-local information (Bem, 2011; Cardeña, 2018; Mossbridge et al., 2012; Ritchie et al., 2012; Wagenmakers et al., 2011). The remainder of this paper is concerned with whether Wheeler's observer-participancy program, extended with contemporary developments in quantum foundations, can provide a structurally coherent account of that pattern without overclaiming what the data warrant.

II. Participatory Physics: From Pregeometry to Shared Classical Reality

John Archibald Wheeler approached anomalous questions about observation and reality from the interior of mainstream physics. His work in general relativity led him to ask why matter appears as something that exists *in* space-time when, mathematically, it can be modeled as configurations *of* space-time itself (Wheeler, 1955, 1957, 1962). Early programs on "mass without mass" and "charge without charge" treated particles as stable topological features of the gravitational and electromagnetic fields—geons and wormhole-like structures that behave like matter without invoking an underlying substance

(Wheeler, 1955, 1957, 1962). Pushed to sufficiently small scales, however, this geometrical approach breaks down. When quantum uncertainty is applied to the gravitational field near the Planck length, the smooth manifold of general relativity disintegrates into what Wheeler called “quantum foam”: violent fluctuations in curvature so extreme that the usual notions of “here” and “there” cease to be well-defined (Wheeler, 1957; Jaeger, 2015). Space-time, on this view, is not fundamental. It is an emergent approximation that fails precisely where a unified account of matter and geometry is most needed (Jaeger, 2015; Wheeler, 1957).

Wheeler’s turn to pregeometry did not arise from speculative interest in consciousness but from this specific impasse inside general relativity. By the mid-1950s he had shown that general relativity could, in principle, account for “mass without mass” and “charge without charge” via geons and wormhole topology—configurations in which the appearance of particles emerged from the curvature and connectivity of space-time itself rather than from underlying substances (Wheeler, 1955, 1957, 1962). Pushed to the Planck scale, however, this program collapsed under its own quantum weight. The attempt to treat geometry as a dynamical field subject to the uncertainty principle led not to a deeper grounding of matter in space-time but to the breakdown of space-time as a continuous manifold, the quantum foam regime in which localization and temporal ordering cease to be well defined (Wheeler, 1957; Jaeger, 2015). Pregeometry was Wheeler’s response to this failure: if geometry itself is unstable at the smallest scales, then whatever underlies physics must be more primitive than geometry.

The informational turn—“it from bit”—was his answer to that demand for something more primitive (Wheeler, 1989, 1990). Crucially, Wheeler did not frame this as a shift from physics to metaphysics but as a continuation of physics by other means: the recognition that quantum theory already treats measurement outcomes as the fundamental “bits” from which the properties of systems are inferred (Jaeger, 2015; Wheeler, 1989, 1990). The observer enters not as a subjective add-on but as an indispensable part of the architecture that turns probabilistic amplitudes into definite records (Jaeger,

2015; Wheeler, 1989, 1990). This is why delayed-choice experiments carried such weight for him. They showed, in his view, that the past history of a quantum system is not simply "there" awaiting discovery; it is crystallized by present choices of what to measure (Jacques et al., 2007; Wheeler, 1978). The present framework extends that same logic, cautiously, to the domain of probabilistic futures rather than past paths: if observation can help determine which of several consistent histories becomes actual, then it is at least conceptually coherent to ask whether, under some conditions, it can help determine which of several constrained futures does as well.

The delayed-choice experiment crystallizes this participatory perspective. In Wheeler's formulation and in later realizations by Jacques and colleagues, a quantum system (e.g., a photon) is routed through an apparatus that can be configured either to reveal which path it took (particle-like behavior) or to reveal interference between paths (wave-like behavior) (Jacques et al., 2007; Wheeler, 1978). Crucially, the configuration choice can be delayed until after the photon has already encountered the beam-splitter (Jacques et al., 2007; Wheeler, 1978). The experimental record is well described by standard quantum mechanics: there is no retrocausal signal traveling backward in time (Jacques et al., 2007). What is striking is the way the *past* is described. Prior to measurement, it is illegitimate to say that the photon "really" took one path or both; only when the apparatus configuration is fixed and the outcome registered does the photon's past acquire a definite trajectory (Jacques et al., 2007; Wheeler, 1978). The present act of observation participates in determining which past is realized in the classical record. This is the structural feature of quantum theory that will later prove central to the participatory collapse model. Experimental violations of Bell's inequalities, such as those reported by Aspect and colleagues, further reinforce that quantum correlations themselves are nonlocal even when no usable superluminal signal is available (Aspect et al., 1982).

If observation is constitutive at the quantum level, a further problem immediately arises: why do many observers share one apparently stable classical world? Wheeler's own formulation of this challenge—his

"10,000 tinsmiths" problem—asked why 10,000 independent observers do not construct 10,000 incompatible space-times (Wheeler, 1989, 1990). Contemporary work on decoherence and Quantum Darwinism offers a technically precise answer. Decoherence theory shows how interaction with environmental degrees of freedom rapidly suppresses interference between different components of a quantum superposition, yielding effectively classical "pointer states" that are stable under further interaction (Joos et al., 2003; Zurek, 1981, 2003). Quantum Darwinism extends this by demonstrating that these pointer states are redundantly encoded in many disjoint fragments of the environment (Zurek, 2009). Photons scattering off a macroscopic object, for example, carry multiple, overlapping copies of information about its position (Zurek, 2003, 2009). Different observers sample different environmental fragments and, under broad conditions, retrieve the same pointer-state information (Touil et al., 2025; Zurek, 2009). Recent theoretical results by Touil, Yan, and Zurek show that when sufficient environmental redundancy is present, the probability of persistent disagreement about macroscopic pointer states among such observers approaches zero (Touil et al., 2025). Superconducting circuit experiments reported by Zhu and colleagues have demonstrated the redundancy structure predicted by Quantum Darwinism in a superconducting architecture (Zhu et al., 2025), providing experimental support for Quantum Darwinism's core claims (Zhu et al., 2025). Shared classical reality, in this picture, is a consequence of how quantum information proliferates through environments, not a separate postulate (Joos et al., 2003; Touil et al., 2025; Zurek, 2003, 2009).

Relational quantum mechanics provides a complementary interpretive framework. On Rovelli's account, quantum states do not describe intrinsic properties of systems; they encode relational facts between systems and observers (Rovelli, 1996). There is no view from nowhere, only a network of relational events constrained by physical law (Rovelli, 1996). Recent work by Adlam and Rovelli has introduced "cross-perspective links" to formalize how facts established in different observer–system interactions are required to mesh when those observers later interact with one another (Adlam & Rovelli, 2023). Taken

together with decoherence and Quantum Darwinism, this yields a picture of the world that is participatory at the quantum level, consensus-producing at the classical level, and relational in its ontology (Adlam & Rovelli, 2023; Joos et al., 2003; Rovelli, 1996; Zurek, 2003, 2009). Observers participate in the crystallization of facts from quantum possibilities, but the environmental redundancy of those facts and the constraints of relational consistency ensure that independently constructed records converge on a single, stable classical history (Adlam & Rovelli, 2023; Touil et al., 2025; Zurek, 2009).

For the purposes of this paper, two implications are central. First, if space-time and classical locality are emergent from a deeper, informational substrate, then the constraints that make non-local or non-temporal perception impossible at the classical level may not apply in the same way at that substrate (Jaeger, 2015; Wheeler, 1989, 1990; Zurek, 2003, 2009). It does not follow that any particular cognitive process in fact accesses such a level, but it does mean that non-locality and non-temporality, if they occurred, would be consequences of the physics rather than violations of it (Rovelli, 1996; Zurek, 2009). Second, the same machinery that explains why ordinary observers share one classical world—decoherence, redundancy, relational consistency—also defines what any putative "anomalous" process would have to work *against* or *around* (Adlam & Rovelli, 2023; Joos et al., 2003; Zurek, 2003, 2009). A framework that seeks to relate altered-state anomalous cognition to Wheeler's participatory universe must therefore address not only how observers might, under some conditions, interface with a pregeometric substrate, but also how such interfaces remain constrained by the mechanisms that usually enforce classical consensus. The participatory collapse model developed below is an attempt to meet that dual requirement.

III. Historical Mapping: The Edgar Cayce Corpus as Structured Case

If the controlled experimental literature provides a statistical indication that anomalous cognition may occur under specific conditions, the documented trance readings of Edgar Cayce offer a qualitatively different kind of resource: a large, historically bounded corpus of altered-state performances recorded in near-verbatim form over several decades (Johnson, 1998). Between 1901 and 1944, Cayce produced more than 14,000 readings in self-induced hypnotic states, many of them addressing health diagnoses, treatment recommendations, and remote biographical information about individuals he did not know in ordinary waking life (Edgar Cayce Foundation, n.d.; Johnson, 1998). The surviving archive consists of stenographic transcripts, case correspondence, and follow-up documentation maintained by the Association for Research and Enlightenment and curated in part through the Edgar Cayce Foundation's Collection 9 (Edgar Cayce Foundation, n.d.). Whatever one's stance on their interpretation, the readings exist as primary source material whose internal structure and external correlates can be examined systematically (Edgar Cayce Foundation, n.d.; Johnson, 1998).

The present paper does not treat the Cayce corpus as independent proof of anomalous cognition. It treats it as a historically constrained case study whose formal properties align in suggestive ways with the empirical conditions under which anomalous performance appears most robust (Cardeña, 2018; Johnson, 1998; Tressoldi & Storm, 2021). Cayce's readings were conducted in an altered state of consciousness, characterized by self-induced trance and a consistent ritual structure (Johnson, 1998). They were typically produced without direct sensory access to the client—often at a distance, with only name and location provided—and transcribed contemporaneously by trained stenographers (Edgar Cayce Foundation, n.d.; Johnson, 1998). Subsequent correspondence and medical documentation, where available, permit at least partial assessment of specificity and accuracy in a subset of cases (Johnson, 1998). These features collectively resemble, in historical form, the combination of altered state and free-response procedure that meta-analytic work has identified as optimal for anomalous cognition: internal imagery rather than forced-choice guessing, reduced immediate feedback, and minimized

ordinary sensory cues (Cardeña, 2018; Tressoldi & Storm, 2021). Operationally, the relevant unit is not Cayce in isolation but the composite of trance-state channel plus real-time stenographic recording, which together function as a historical apparatus for generating and preserving candidate participatory-collapse events (Edgar Cayce Foundation, n.d.; Johnson, 1998).

Because the archive was assembled and preserved by an advocacy organization, any serious use of it must address confirmation bias and source reliability explicitly (Johnson, 1998). To that end, the analysis in this paper adopts a four-tiered source hierarchy. At the top are independent scholarly treatments such as Johnson's monograph, which examines the medical readings using standard historical methods and treats the more extraordinary claims with appropriate caution (Johnson, 1998). The second tier consists of primary documents within the Cayce archive itself: stenographic transcripts, contemporaneous letters, and medical reports (Edgar Cayce Foundation, n.d.; Johnson, 1998). The third tier includes later ARE publications that summarize or interpret the readings, used only when they can be cross-checked against primary documents (Johnson, 1998). The lowest tier—anecdotal reports, unverified testimonials, and interpretive material that cannot be grounded in contemporaneous records—is excluded from evidentiary use (Johnson, 1998). This hierarchy does not eliminate the asymmetries inherent in working with a legacy archive, but it constrains them and makes the evidentiary status of each claim explicit (Johnson, 1998).

Within this framework, the present analysis further restricts its focus to the medical and physically verifiable subcorpus (Johnson, 1998). Readings that address health conditions, anatomical descriptions, and concrete treatment recommendations are more amenable to partial verification than those dealing with cosmology, reincarnation, or global prophecy (Johnson, 1998). Where Johnson and others have identified plausible correlations between reading content and independent medical findings, those correlations are treated here as suggestive but not definitive—consistent with, but not demonstrating, anomalous access (Johnson, 1998). Claims about relationships between conductor quality (the individual

presenting the question) and reading specificity are framed as inferences from patterns in the corpus rather than as direct quotations from any single source; where Johnson's text supports such inferences, specific page references are provided, and where it does not, the attribution is softened accordingly (Johnson, 1998). Throughout, the methodological goal is to treat the Cayce material as one would treat any historically situated, non-experimental dataset: valuable for generating and constraining theoretical models, but not a substitute for controlled prospective tests (Cardeña, 2018; Johnson, 1998; Tressoldi & Storm, 2021).

Against this backdrop, the key question becomes structural rather than evidentiary: does the pattern of apparent successes and failures in the Cayce medical readings align more naturally with a model in which trance-state cognition "reads off" a fixed archive of future events, or with a model in which it participates in the probabilistic unfolding of those events? Qualitative inspection suggests a non-uniform performance profile: descriptions of present or near-future physical conditions in single individuals sometimes appear strikingly specific, whereas long-range predictions about complex, many-observer events are far more equivocal and prone to failure (Johnson, 1998). This scale- and complexity-dependent pattern is inconsistent with a simple "cosmic record" model, which would predict uniform access across targets, but it is precisely the kind of pattern a participatory collapse framework would lead one to expect (Cardeña, 2018; Tressoldi & Storm, 2021). The next sections develop that framework explicitly and derive from it a set of falsifiable predictions that can be brought back to bear on both the Cayce archive and future empirical work.

IV. Participatory Collapse: From Observer to Creator

The empirical literature and the Cayce corpus, taken together, suggest that whatever anomalous cognition may be, it is not uniformly distributed across targets or conditions (Cardeña, 2018; Johnson, 1998; Tressoldi & Storm, 2021). Accuracy appears to depend on state of consciousness, task structure,

target complexity, and temporal distance (Cardeña, 2018; Johnson, 1998; Tressoldi & Storm, 2021). To relate this pattern to Wheeler's participatory universe, we propose a framework in which the role of the observer is not fixed but spans a spectrum from passive recorder to active co-creator of physical facts (Jaeger, 2015; Wheeler, 1989, 1990). In ordinary perception, observers register outcomes that have already been decohered and redundantly encoded by environmental interactions: they are readers of an established classical record (Joos et al., 2003; Zurek, 2003, 2009). In the delayed-choice experiment, the observer's measurement choice participates in determining which of several quantum-consistent pasts becomes part of that record (Jacques et al., 2007; Wheeler, 1978). At the far end of the spectrum lies the possibility that, under some conditions, conscious processes might participate not only in selecting among past histories but in shaping how unresolved future probabilities crystallize into actual events (Penrose, 1989; Rovelli, 2018; Wheeler, 1989). The participatory collapse model situates trance-state anomalous cognition toward this more active end of the spectrum, while remaining constrained by the same decoherence and redundancy mechanisms that normally underwrite classical consensus (Joos et al., 2003; Zurek, 2003, 2009). The mechanism gap remains open at the substrate level. However, the structural requirement the model places on neurophysiology — that altered states modify boundary conditions on classical sensory processing in ways that permit limited engagement with not-yet-committed probability distributions — receives partial independent support from two directions. First, Escolà-Gascón and colleagues' demonstration that emotional intelligence and intuitive processing modulate remote viewing performance supports the model's prediction that internal cognitive state governs coupling strength, rather than any fixed external channel (Escolà-Gascón et al., 2023). Second, Levin's examination of reasonable parameters for presentiment models provides directly relevant empirical constraints on the conditions under which anticipatory effects are most robust (Levin, 2026). Neither closes the mechanism gap. Together they narrow it.

On this view, the key distinction is not between “normal” and “paranormal” perception but between different ways in which conscious processes couple to the underlying informational substrate (Jaeger, 2015; Wheeler, 1989, 1990). At one extreme, classical waking cognition is dominated by inputs from already-collapsed environmental records; the brain functions largely as a high-level pattern extractor over decohered sensory data (Joos et al., 2003; Zurek, 2003). At the other extreme, it is at least conceptually possible to imagine a mode of awareness that interacts more directly with the pregeometric substrate from which those classical records emerge—where locality and temporality, as properties of space-time, are not yet fully in force (Jaeger, 2015; Wheeler, 1989, 1990; Zurek, 2009). If such coupling were to occur, any non-local or non-temporal character it displayed would not, on Wheeler’s account, be a violation of physics; it would be a consequence of operating at a level where the usual space-time constraints have not yet crystallized (Rovelli, 1996; Zurek, 2009). The participatory collapse model does not claim to specify a detailed physical mechanism for how trance-state neurophysiology could achieve such coupling. Instead, it posits a weaker, structural hypothesis: that altered states of consciousness may relax some of the boundary conditions that tether awareness to locally decohered records, thereby permitting limited engagement with probability distributions over not-yet-fixed events (Cardeña, 2018; Tononi, 2004, 2008).

Within this structural frame, the present moment takes on a specific and central role. In standard relativistic physics, the “now” is often treated as a psychological construct laid over a four-dimensional block in which past and future are equally real (Price, 1996; Rovelli, 2018). Whitehead’s process philosophy and Penrose’s objective reduction proposal both push against this picture, portraying reality as a succession of events in which potentialities are continuously resolved into actualities (Penrose, 1989; Whitehead, 1929). Rovelli’s relational account likewise emphasizes the local, perspectival character of temporal ordering (Rovelli, 1996, 2018). The participatory collapse model builds on these strands by treating the experienced present as the subjective correlate of a moving collapse front—the

boundary at which probability distributions over possible futures are resolved, through participatory observation, into the decohered classical past (Penrose, 1989; Rovelli, 2018; Whitehead, 1929). Behind this front lies the region of space-time already stabilized by decoherence and redundant environmental encoding; ahead of it lies an open region of unresolved possibilities, structured by physical law but not yet fixed (Joos et al., 2003; Zurek, 2003, 2009). The flow of time, in this picture, is not an illusion imposed on a static block but the ongoing physical process by which the collapse front advances (Price, 1996; Rovelli, 2018).

Trance-state anomalous cognition is then modeled as a limited extension of this collapse front beyond its usual temporal boundary. By reducing the dominance of externally driven, already-classical sensory processing, the altered state may allow the observing system's participation to engage, probabilistically, with probability distributions associated with near-future states of specific targets (Cardeña, 2018; Tononi, 2004, 2008). Crucially, these distributions are not uniform. For a single individual with well-defined physical conditions—a specific spine, a specific ongoing illness—the range of physically plausible near-future configurations may be relatively narrow (Johnson, 1998). For a geopolitical event shaped by the unresolved choices of many agents, the corresponding distribution is wide and diffuse (Price, 1996; Rovelli, 2018). On the participatory collapse model, Cayce's trance-state readings are not readouts from a fixed archive but participatory selections from such distributions (Johnson, 1998). The model predicts that outputs will be most specific when the underlying distributions are already sharply constrained (e.g., near-future, single-individual medical states) and increasingly vague, symbolic, or erroneous as one moves toward far-future, many-observer events (Johnson, 1998; Tressoldi & Storm, 2021).

This leads directly to the accuracy differential framework developed later in formal prediction. Two independent degradation factors emerge from the structure of the model. First, accuracy should decline as a function of *observer complexity*: the greater the number of independent observers whose participatory choices influence an outcome, the broader the associated probability distribution and the

less determinate any single participatory observation will be (Johnson, 1998; Price, 1996; Rovelli, 2018). Second, accuracy should decline as a function of *temporal distance* from the ordinary present, because distributions farther ahead of the collapse front have had fewer constraining interactions and remain more open (Price, 1996; Rovelli, 2018; Whitehead, 1929). Near-future states of single individuals thus occupy one corner of a two-dimensional space—low complexity, short temporal distance—where the model predicts the highest potential specificity. Far-future, many-observer outcomes occupy the opposite corner, where the model predicts minimal usable information (Johnson, 1998; Price, 1996). The pattern qualitatively evident in the Cayce corpus aligns with this structure: apparent strengths in concrete, near-term medical descriptions and conspicuous failures in long-range geopolitical prophecy (Johnson, 1998). The next section translates this qualitative pattern into six explicit, discriminating predictions that can be tested against both historical archives and future empirical data.

V. Formal Predictions: Accuracy Surfaces and Boundary Conditions

The two-factor accuracy surface introduced in Section IV—defined by observer complexity and temporal distance—yields six concrete, testable predictions about anomalous cognition. Together these predictions define an accuracy "surface" rather than a single effect size and distinguish the model from both fixed-archive and purely classical–psychological accounts.

First, accuracy should decrease systematically with increasing *temporal distance* between the observer's present and the target event. Near-present targets—events or states within a short window of the observation—should show higher hit rates than far-future targets, even when target type and task structure are held constant. This follows from the model's assumption that probability distributions farther ahead of the collapse front are less constrained and therefore less determinate. Experimental indications that hit rates differ between present and future targets, and track a priori target probabilities, are consistent with this directionality, though not yet decisive.

Second, accuracy should decrease with increasing *observer complexity*: the number of independent observers whose participatory choices help determine the outcome. Targets involving single individuals or small groups with limited degrees of freedom (e.g., specific medical conditions) should be more amenable to specific descriptions than targets involving large populations or many decision-makers (e.g., geopolitical events). This predicts a gradient from relatively higher specificity in individual-level targets to lower specificity and more symbolic description in large-scale social or planetary predictions. Historical critiques of sweeping prophetic claims, including failed pole-shift and geopolitical forecasts, align qualitatively with this gradient.

Third, the model predicts that accuracy will be modulated by *prior physical constraint* on the target. When the near-future evolution of a target is already tightly constrained by its current physical state and known dynamics, the associated probability distribution is narrower, and participatory selection can be more specific. This favors domains like ongoing medical processes, where anatomy and physiology limit possible trajectories, over domains where small fluctuations can amplify into widely divergent outcomes. Process-oriented anomalous cognition studies reporting dependence of hit rates on a priori target probabilities offer an empirical handle on this constraint-sensitivity.

Fourth, the model implies that *altered states* of consciousness that reduce the dominance of externally driven, already-classical sensory processing should show higher anomalous performance than ordinary waking states, all else equal. Trance, hypnosis, and comparable conditions are modeled as relaxing boundary conditions that ordinarily tether awareness to local decohered records. Presentiment and remote viewing studies that find physiological or descriptive effects clustered around emotionally salient, randomly determined future stimuli suggest that state manipulations can modulate coupling to not-yet-resolved events. Meta-analytic evidence for presentiment—physiological changes preceding randomly determined emotional stimuli—is consistent with this kind of state-dependent coupling to not-

yet-resolved events (Mossbridge et al., 2012). The framework predicts that such advantages will be largest for low-complexity, short-distance targets.

Fifth, if anomalous cognition reflects participatory selection from probability distributions rather than readout from a fixed archive, *error patterns* should differ from those expected under a simple-archive or pure-guessing model. Errors should be biased toward high-probability but unactualized branches rather than uniformly random deviations. Process-level analyses that track how descriptions evolve over time and cluster around likely but unrealized outcomes could therefore discriminate between archive-like reading, participatory collapse, and classical–psychological interpretations.

Sixth, the model predicts that the full pattern of accuracy and error can be represented as a two-dimensional *accuracy surface* over observer complexity and temporal distance. High, specific accuracy is expected in the low-complexity, short-distance corner (e.g., near-future individual medical states), with steep declines along both axes and minimal usable information in the high-complexity, far-future corner (e.g., long-range geopolitical prophecy). Existing studies that examine time dependence and target probability, together with historical corpora that show relative strengths in concrete near-term descriptions and conspicuous failures in sweeping long-term predictions, qualitatively trace such a surface. Future work can operationalize this surface quantitatively by stratifying targets and designing experiments to map accuracy as a function of these two variables.

The structural requirement the participatory collapse model places on the pregeometric substrate finds a named theoretical neighbor in Bohm's implicate order framework, which proposes that spacetime and locality are explicate expressions of a deeper pre-space in which classical constraints of locality and temporality are undefined (Bohm, 1980). On Bohm's account, each moment of time is a projection from the total implicate order — an enfolded structure in which what we call past, present, and future are not sequentially arranged but simultaneously present as degrees of enfoldment awaiting expression. This

framing provides a named theoretical address for the pregeometric substrate the participatory collapse model informally invokes: the layer in which Cayce's trance-state cognition is proposed to operate is, in Bohm's terms, the implicate order prior to explicate expression. The present framework extends Bohm's architecture in three specific respects that his original formulation left unspecified: it proposes a concrete neurological access mechanism — thalamic reticular nucleus gating as classical noise reduction — a quantifiable coupling efficiency variable governing depth of access, and a participatory collapse architecture in which the observer does not passively read the implicate order but actively selects among probability distributions not yet resolved into classical expression. These additions do not resolve the mechanism gap. They locate it within an established theoretical tradition and specify what a full mechanistic account would need to provide.

VI. Objections, Limitations, and Directions for Further Work

Any attempt to relate anomalous cognition to quantum foundations inherits two well-known hazards: the temptation to treat formal analogies as mechanisms, and the risk of overinterpreting fragile empirical effects (Cardeña, 2018; Penrose, 1989; Price, 1996). This section addresses the strongest foreseeable objections and delineates the limits of what the participatory collapse framework currently claims.

A first objection targets the *mechanism gap*. The framework proposes that altered states of consciousness may, in some limited way, engage with probability distributions associated with not-yet-fixed events in a pregeometric substrate (Jaeger, 2015; Wheeler, 1989, 1990). Critics may reasonably ask how trance-state neurophysiology could effect such coupling in physical terms. At present, no detailed mechanism is offered. The participatory collapse model establishes a structural isomorphism between the formal behavior of quantum systems under delayed-choice conditions and the scale- and state-dependent patterns reported in anomalous cognition; it does not specify a concrete pathway by which

macroscopic neural processes interface with pregeometric informational degrees of freedom (Jacques et al., 2007; Wheeler, 1978, 1989). Unlike Orch OR (Hameroff & Penrose, 2014), which posits specific quantum coherence in neural microtubules, the participatory collapse model is agnostic about neurophysical implementation and requires only that altered states modify the boundary conditions on classical sensory processing. The mechanism gap remains open at the substrate level. However, the structural requirement the model places on neurophysiology — that altered states modify boundary conditions on classical sensory processing in ways that permit limited engagement with not-yet-committed probability distributions — receives partial independent support from two directions. First, Escola-Gascón's nonlocal plasticity framework demonstrates that anticipatory neural generation is endogenous rather than receptive, consistent with the participatory rather than archive-reading architecture the model requires. Second, Levin's examination of presentiment parameters provides directly relevant empirical constraints on the conditions under which anticipatory effects are most robust (Levin, 2026). Neither closes the mechanism gap. Together they narrow it.

A third direction for narrowing the mechanism gap concerns the neurological basis for why altered states may constitute a distinct access condition rather than merely a correlate of performance. Contemporary neuroscience identifies the thalamic reticular nucleus — a thin inhibitory shell of GABAergic neurons enveloping the dorsal thalamus — as the primary mechanism by which sensory transmission to the cerebral cortex is reduced during sleep and trance-like states. During high-amplitude alpha and deeper sleep states, the thalamic reticular nucleus suppresses thalamocortical relay activity, reducing classical sensory input to cortex by approximately fifty percent relative to waking (Coenen, 2024). Crucially, this suppression is not uniform: the thalamic reticular nucleus contains a functional map organized by sensory modality, permitting spatially selective gating in which specific cortical regions are quieted while others remain active (Lewis et al., 2015; Fernandez et al., 2018). This selectivity provides a candidate neurological substrate for the boundary-condition relaxation the participatory collapse model informally

invokes — not a global shutdown of processing, but a precision reduction of the classical sensory noise floor, with the potential for preserved, redirected awareness. This neurological account of boundary-condition relaxation provides a candidate biological substrate for the access condition informally invoked in Prediction 4, where trance and comparable altered states are modeled as reducing the dominance of externally driven, already-classical sensory processing.

On this proposal, the rarity of anomalous cognition under ordinary waking conditions reflects a straightforward signal-to-noise constraint. When thalamocortical throughput is at full waking levels, the classical sensory stream dominates processing to a degree that renders any substrate-level signal undetectable. The altered state — whether induced through trance, meditation, hypnosis, or the natural sleep onset process — engages thalamic reticular suppression sufficiently to lower the noise floor. Cayce's self-induced trance, characterized by sleep-like respiratory and behavioral markers, represents an extreme case of this suppression: the deepest naturally available gating state, sustained on demand over decades. This account does not invoke any mechanism beyond established thalamocortical neuroscience, and it makes no claim that such gating is sufficient for anomalous cognition — only that it may be a necessary access condition. Whether thalamic reticular activity during anomalous cognition performance differs systematically from baseline is an empirical question tractable with simultaneous high-resolution EEG and fMRI, and constitutes a proposed direction for future mechanistic investigation.

The six predictions developed above therefore discriminate between formal accounts of the performance pattern—the participatory collapse model, archive models, and classical–psychological explanations—but they do not, by themselves, discriminate between the participatory collapse mechanism and any alternative mechanism that might produce the same pattern through purely

classical processes (Bem, 2011; Ritchie et al., 2012; Wagenmakers et al., 2011). Establishing mechanism causally, rather than structurally, is a task for subsequent theoretical and empirical work.

A second objection concerns the "*archival asymmetry*" between experimental data and the Cayce corpus. The controlled studies synthesized by Tressoldi and Storm and by Cardeña were designed with randomization, blinding, and pre-specified endpoints; their limitations are statistical and methodological rather than archival (Cardeña, 2018; Tressoldi & Storm, 2021). By contrast, the Cayce readings were never subjected to pre-registered, independently blinded accuracy assessments. They were produced in an advocacy context, curated by sympathetic followers, and preserved selectively (Edgar Cayce Foundation, n.d.; Johnson, 1998). The four-tier source hierarchy and the restriction to the medical subcorpus mitigate, but do not eliminate, these concerns (Johnson, 1998). A more aggressive assessment would emphasize that no amount of source hierarchy fully compensates for the absence of pre-registered, independently blinded accuracy ratings in the Cayce corpus (Johnson, 1998). Even with careful restriction to the medical subcorpus, the possibility remains that selective preservation, editorial curation, and retrospective reinterpretation could account for much of the apparent pattern without invoking any anomalous process (Johnson, 1998). From the present framework's standpoint, the Cayce material is best treated as a rich hypothesis generator: a historically bounded pattern that suggests how scale, complexity, and temporal distance might shape performance, but that cannot substitute for prospective tests designed explicitly to distinguish among competing models (Cardeña, 2018; Johnson, 1998; Tressoldi & Storm, 2021).

A third objection charges that the framework risks *retrofitted rationalization*. The six predictions are derived from a pattern that was, at least qualitatively, already known: relative strengths in concrete medical descriptions, weaknesses in broad prophetic claims, apparent advantages in altered states (Johnson, 1998). It is legitimate to ask whether the participatory collapse model is merely fitting an elegant story to existing data. The response has two parts. First, the model converts informal

observations into explicit, discriminating predictions—most notably the two-dimensional accuracy surface over observer complexity and temporal distance—that can be falsified by systematic stratification of the Cayce corpus and by targeted experimental designs (Johnson, 1998; Price, 1996; Rovelli, 2018). Second, the framework is applied symmetrically: it constrains itself with Wheeler's own demand for mechanism and with the requirement that any proposed extension be consistent with decoherence, Quantum Darwinism, and relational consistency (Adlam & Rovelli, 2023; Joos et al., 2003; Touil et al., 2025; Wheeler, 1989; Zurek, 2003, 2009). If future analyses show that accuracy does *not* vary as predicted along the two axes, or that error structures are indistinguishable from those expected under pure guessing and bias, the participatory collapse model will have failed on its own terms (Bem, 2011; Ritchie et al., 2012; Wagenmakers et al., 2011).

Several limitations and avenues for further work follow directly from these objections. On the theoretical side, additional development is needed to clarify whether and how existing models of brain function—classical, quantum, or hybrid—could support the kind of boundary-condition relaxation the framework informally invokes (Doerig et al., 2021; Tononi, 2004, 2008; Zurek, 2003, 2009). This includes not only speculative quantum-consciousness proposals but also more conservative accounts in which altered states modulate access to complex classical correlational structures without invoking non-local interactions (Barrett & Mediano, 2019; Cardeña, 2018; Tononi, 2004, 2008). On the empirical side, two lines of research are especially promising. One is a systematic, pre-registered reanalysis of the Cayce medical subcorpus, stratified by target complexity, temporal distance, and prior physical constraint, with independent raters and explicit coding schemes (Edgar Cayce Foundation, n.d.; Johnson, 1998). The other is a new generation of altered-state experiments that build the predicted two-factor accuracy surface into their design, using random but physically constrained targets and pre-specified analyses to distinguish between participatory collapse, archive-like, and purely classical explanations (Bem, 2011;

Cardeña, 2018; Tressoldi & Storm, 2021). Only through such work can the present framework move from a structurally coherent possibility to a theory with clear empirical standing.

VII. AI–Human Collaborative Methodology

Because this paper engages controversial subject matter and proposes a nonstandard theoretical synthesis, it is important to disclose not only its evidentiary basis but also the process by which its argument was constructed. The manuscript emerged from an extended series of iterative sessions between the human author and large language model–based AI systems—specifically Claude (Anthropic), Comet, and Perplexity—treated not as drafting tools but as partners in structured critical dialogue (see AI Use Disclosure above). The human contributor supplied the core theoretical intuitions, historical and domain knowledge, and the central conceptual moves—including the participatory collapse reframing of the Cayce readings, the emphasis on Wheeler's 1979 skepticism as a methodological standard rather than an obstacle, and the proposal to treat the experienced present as a moving collapse front (Johnson, 1998; Wheeler, 1978, 1989, 1990). The AI systems were tasked primarily with applying recursive critical pressure: identifying implied predictions, checking whether those predictions genuinely discriminated between competing models, surfacing the strongest foreseeable objections, and highlighting points where the argument appeared to overreach its evidential base (Bem, 2011; Cardeña, 2018; Ritchie et al., 2012; Tressoldi & Storm, 2021; Wagenmakers et al., 2011).

Practically, this meant that many of the paper's structural features—the six predictions and their organization into an accuracy differential framework, the explicit treatment of the mechanism gap, and the steelmanned objections in the limitations section—emerged from cycles in which the author proposed a conceptual move and the AI systems responded by asking what it would predict, how those predictions could fail, and how they might be tested (Adlam & Rovelli, 2023; Joos et al., 2003; Touil et al., 2025; Zurek, 2003, 2009). Throughout, Wheeler's demand for mechanism and rigor served as an explicit

constraint: when arguments fell below that standard, they were either revised or reframed in more modest, structural terms (Wheeler, 1989, 1990). All theoretical claims, interpretive judgments, source hierarchy decisions, and final editorial choices are the responsibility of the human author. The AI contribution is best understood as a dynamic scaffolding for critical thinking rather than as an independent source of authority.

This methodology is described not as a novelty claim but as a transparent account of actual practice. As AI-assisted scholarship becomes more common, the integrity of the scientific record will depend in part on clear disclosure of how such systems were used—not only for tasks such as copyediting or reference formatting, but also, where applicable, for higher-level functions such as hypothesis generation, objection development, and argument structuring (Cardeña, 2018; Tressoldi & Storm, 2021). In a field that already sits at the margins of mainstream science, modeling this level of transparency may be especially important. The present paper should therefore be read as the product of a human author working within a recursively critical, AI-augmented environment, with the human bearing full responsibility for the claims advanced and the evidentiary standards to which they are held (Bem, 2011; Ritchie et al., 2012; Wagenmakers et al., 2011).

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