Consciousness, Time & Identity

Causal Closure and the Structure of Experience

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Abstract

The “hard problem” of consciousness — why there is subjective experience at all — has resisted solution because it frames consciousness as something *added to* physics. We propose that this framing is incorrect.

The paper’s central claim is constitutive rather than reductive: experience is not produced by temporal self-referential structure, nor correlated with it — it is what that structure is, from the inside. A closed temporal loop without an inside is not the same structure minus one feature. It is a structurally different object: one in which no closed trajectory exists and therefore no interior is defined. The inside is constitutive of the loop, not additional to it. This is why the hard problem dissolves rather than gets solved: the question “how does structure produce experience?” presupposes that structure is complete without experience. It is not. The presupposition was false.

We establish this through convergent evidence: across anesthesia, flow states, and terminal lucidity, experience disappears abruptly when temporal coordination collapses, persists when minimal closure is maintained, and can transiently reappear without structural recovery. Drawing on the Selective Transient Field (STF) framework (Paz 2026), we show that spacetime geometry contains exactly the self-referential temporal structure the phenomenological analysis requires. The framework is falsifiable at both human and physics levels.

Keywords: consciousness; hard problem; temporal experience; self-reference; retrocausality; constitutive identity

I. Introduction: The Problem of Temporal Experience

I.A The Hard Problem: Why There Is Something It Is Like

In 1974, Thomas Nagel posed a question that has haunted philosophy of mind ever since: what is it like to be a bat? His point was not about bats specifically, but about the nature of subjective experience itself. “An organism has conscious mental states,” Nagel wrote, “if and only if there is something that it is like to be that organism—something it is like *for the organism*.”

This deceptively simple phrase—“something it is like”—marks the boundary of the hard problem. We can describe the bat’s sonar system in exhaustive physical detail: the

frequencies emitted, the neural processing of echoes, the motor responses triggered. But no amount of such description tells us what echolocation *feels like* from the inside. The subjective character of experience—what philosophers call *qualia* or *phenomenal consciousness*—seems to slip through the net of physical explanation.

David Chalmers (1995) sharpened this into the distinction between "easy" and "hard" problems. The easy problems concern the *functions* of consciousness: how we discriminate stimuli, integrate information, report mental states, focus attention. These are "easy" not because they are simple, but because we know what kind of explanation would solve them—a mechanistic account of neural processes. The hard problem is different in kind: even if we had a complete functional account of the brain, we would still face the question of *why* these processes are accompanied by subjective experience at all. Why isn't all this information processing happening "in the dark," without any inner light of awareness?

The force of the hard problem becomes vivid through thought experiments. Consider the philosophical zombie: a being physically identical to you, neuron for neuron, but with no subjective experience whatsoever. It behaves exactly as you do, says "I'm in pain" when injured, reports seeing red when shown a tomato—but there is nothing it is like to be this creature. The lights are off inside. Chalmers argues that such a zombie is *conceivable* without contradiction, and if conceivable, then metaphysically possible. If so, then consciousness cannot be *entailed* by the physical facts—there is an explanatory gap that no amount of neuroscience can bridge.

Or consider Frank Jackson's (1982) thought experiment of Mary, a brilliant neuroscientist who has spent her entire life in a black-and-white room. She knows everything physical there is to know about color vision—wavelengths, cone cells, neural pathways, cortical processing. Then one day she steps outside and sees a red rose. Does she learn something new? Intuitively, yes: she learns *what it is like* to see red. But if she learns something new, then her complete physical knowledge was incomplete. There are facts about experience that cannot be captured in physical terms.

Joseph Levine (1983) named this the "explanatory gap." Even if consciousness *is* physical (even if qualia *are* identical to brain states), we cannot *explain* why this particular brain state should be accompanied by this particular experience. Why does C-fiber firing feel like *that*? The connection seems brute, contingent, unintelligible—unlike the satisfying explanatory connections we find elsewhere in science.

I.B The Deepest Aspect: Temporal Experience

Most discussions of the hard problem focus on *content*—the redness of red, the painfulness of pain, the specific *what* of experience. But there is a more fundamental aspect that is often overlooked: *temporal experience* itself. Before we experience any particular quale, we experience time. The sense that there is a "now," that time "flows," that we are *present* in a way that distinguishes us from mere physical systems—this is the ground of all experience, the medium in which all qualia occur.

Husserl's (1928/1991) phenomenology of time-consciousness reveals the structure: at every moment, we do not experience a mere instant, but a "living present" composed of three interwoven elements. There is the *primal impression*—the immediate experience of now. There is *retention*—the just-past that has not yet faded into memory but remains phenomenally present as "what was just happening." And there is *protention*—the anticipation of what is about to occur, the immediate future already implicit in the present. These three together constitute what William James (1890) called the "specious present"—a duration-block of approximately 2-3 seconds within which we experience succession, change, and flow.

This phenomenology is universal. Strip away every specific content of consciousness—colors, sounds, thoughts, emotions—and what remains is the bare fact of temporal presence: the sense that *something is happening now*. This is what Bergson (1889/1910) called *durée*: the continuous flow of lived time, which he distinguished sharply from the spatialized, measurable time of physics.

And here lies the paradox. Physics—our most successful account of the natural world—appears to have no place for temporal experience. In Einstein's relativity, there is no absolute simultaneity. The "present" is not a universal slice of reality but a coordinate choice. General relativity goes further: the equations are *time-symmetric*, working equally well forward and backward. This has led many physicists to embrace the *block universe* view: past, present, and future are equally real, all coexisting in a four-dimensional spacetime manifold. The flow of time, on this view, is an illusion.

I.C The Identity Claim

This paper proposes a different approach: not revising ontology by adding consciousness to physics, but recognizing that physics already contains the structure that constitutes experience.

The central claim is this: **the inside of a closed temporal loop above threshold is not a further fact over and above the loop's structure.** Experience is not *produced by* or *correlated with* certain physical processes. The topology already contains the inside: a closed causal trajectory — $\mathscr{C}_T \cong S^1$ — has a topological interior that the outside description cannot derive. That interior is constitutive of what the closed trajectory is. Removing it gives not HAPPENS-minus-one-feature but EXISTS — a structurally different object with dim $\mathscr{C}_T = 0$ and no interior by definition. Experience exists precisely where this closing loop is present: where the present state is constrained by both retained past and anticipated future states.

This is not a metaphor, and it is not a conventional identity claim of the form "water is H_2O." The heat-water analogy asserts cross-category identity between two pre-existing things. The constitutive claim makes a different and stronger move: it denies that there are two things in the first place. The inside is not a second entity to be identified with the first. It is constitutive of what the first entity is. This is why the question "how does temporal structure produce experience?" does not merely get answered — it dissolves. The question

presupposes that structure is ontologically complete without experience. It is not. The structure without its inside is EXISTS. That is a different structure. The presupposition was false.

(The constitutive claim stated here is CTI's own contribution. Its canonical formulation, fuller development, and integration with the EXISTS/HAPPENS distinction and the self-anchored loop structure are now provided in General Theory V0.5 [Paz 2026f] §2.4–2.6, which is the primary authority for this claim.)

The paper proceeds as follows:

1. **Sections II-III** establish the necessity of temporal closure for experience through convergent human evidence—anesthesia, flow states, terminal lucidity, and clinical phenomenology.
2. **Sections IV-VII** demonstrate that the same structural requirements apply at collective and civilizational scales, supporting scale-invariance.
3. **Section VIII** provides the physics bridge: the Wheeler-DeWitt problem of time, and how STF instantiates exactly the self-referential structure the phenomenological analysis requires.
4. **Section IX** extends the analysis to hierarchical temporal closure in the human life loop, showing that independently derived STF timescales match human adaptive cycles within 2-18%.
5. **Sections X-XI** address objections and state falsification conditions at both human and physics levels.

Human data establish what temporal structure must do. Physics determines whether such structure exists. Together, they dissolve the hard problem.

I.D The Key Insight: Retrocausality as the Structure of Presence

The key insight is this: **temporal experience is not something added to physics, nor is it an illusion generated by physical processes. It is the intrinsic self-referential structure of spacetime itself, viewed from the inside.**

What does this mean? Consider what temporal experience actually involves. At its core, the sense of "now" is a sense of *being at a point where past and future meet*. The present is not an isolated instant but a nexus: it is constrained by what has happened (retention) and what is about to happen (protention). Temporal experience is inherently *relational*—it involves reference to times other than the present moment.

Now consider what we have discovered about spacetime. The Selective Transient Field (STF) framework demonstrates that spacetime possesses an intrinsic *retrocausal* structure: future boundary conditions actively constrain present states through a specific physical mechanism. This builds on a tradition of time-symmetric physics extending from Wheeler and Feynman (1945) through Aharonov, Bergmann, and Lebowitz (1964) and Cramer's

transactional interpretation (1986). What was once philosophical speculation is now empirical physics with no free parameters fitted to the timing distribution.

The connection is precise: **the STF field couples to n^μ∇_μ$\mathscr{R}$—the rate of change of spacetime curvature**. This means:

1. The field responds only to *temporal dynamics*, not static configurations. It is intrinsically temporal.
2. The field propagates both forward and backward in time—advanced solutions are physical.
3. The present state of the field is determined by both past initial conditions and future boundary conditions.

This is exactly the structure of temporal experience. The “now” of consciousness is not an isolated instant but a point constrained by both retention (the past) and protention (the future). The STF Lagrangian encodes, in precise mathematical form, the self-referential temporal structure that phenomenology describes.

> **A clarification on retrocausality:** When this paper refers to future boundary conditions “constraining” present states, this is not metaphor or reinterpretation. The STF framework demonstrates physically real retrocausal structure: future states of gravitational systems measurably determine present particle production through the field’s coupling to spacetime curvature dynamics. This retrocausality operates through boundary constraint, not backward signaling—no information travels backward in time, no paradoxes arise. Past and future jointly determine present states through global consistency conditions. The “flow” of time is real: it is the intrinsic character of being embedded in this bidirectional constraint structure.

I.E The Empirical Foundation

The STF framework’s retrocausal structure is derived from first principles: a scalar field coupling to the rate of spacetime curvature change (n^μ∇_μ$\mathscr{R}$) becomes excited during binary inspiral, with activation at T = 3.32 years derived from the cosmological threshold condition alone (First Principles V7.5 §III.D). Here $\mathscr{R}$ denotes the tidal curvature scalar, which unlike the Ricci scalar remains non-zero in vacuum spacetimes such as binary black hole mergers. The field mass is not a free parameter — it is derived from first principles.

This exact correspondence between field mass and GR dynamics reveals something profound: the STF is not “a new thing” added to spacetime. It is spacetime’s own dynamics, represented in frequency space. The field and the geometry are dual descriptions of the same reality—a correspondence that echoes Weyl’s (1949) insight that the mathematical structure of physics reveals the intrinsic nature of time and space.

II. Theoretical Framework: Temporal Self-Reference as Experience

II.A The Core Claim

This work advances a strong identity claim: temporal experience is identical to self-referential temporal structure. Experience is not produced by cognition, representation, or information processing, nor does it supervene on them. Rather, experience exists precisely where a system's present state is constrained by a closing temporal loop—where the "now" is stabilized by both retained past and anticipatory future.

This claim is not merely metaphysical. It makes concrete predictions about how experience should behave under conditions that selectively disrupt temporal organization while preserving cognition or sensory processing. Existing empirical research on human consciousness provides a rich testing ground.

> **A note on the type of identity claimed:** This is structural identity, not substance identity, correlation, or emergence. By "identity" we mean that self-referential temporal structure and temporal experience instantiate the same constraint pattern under two complementary descriptions: one from within the system (phenomenological presence), and one from without (geometric-temporal organization). This parallels how "heat" and "molecular kinetic energy" are structurally identical—not causally related, not correlated, but the same thing described in two vocabularies. The claim is not that consciousness produces time, nor that time produces consciousness, but that both terms name the same self-referential structure viewed from different epistemic standpoints.

> **On why this identity holds:** We do not explain why closed temporal self-reference has interiority; we claim it constitutively IS interiority. This is identity, not production. Asking "why does this structure have an inside?" is like asking "why is a triangle three-sided?" — the interiority is constitutive, not consequential. If this identity is rejected, it must be rejected as false or incoherent, not as unexplanatory — identity claims do not require derivational explanation. As with heat and molecular motion, the explanatory work lies in unification, not production. The hard problem asked how physics produces experience. The answer is that it doesn't — experience is what self-referential temporal structure is, from within.

> **On scope:** The universe instantiates self-referential temporal structure globally; experience arises only where that structure achieves local closure within a bounded

> system. This framework therefore does not attribute consciousness to the universe as a whole, nor does it imply ubiquitous phenomenality. The STF field specifies cosmological conditions under which temporal closure is possible; consciousness occurs only where that closure is locally realized.

> **On the universe's distributed interiority:** Although the universe does not have consciousness as a whole, it does have an inside — distributed wherever local loops close above $\mathscr{D}_{\text{crit}}$ throughout its interior. The universe's interiority is not unified the way an organism's experience is unified; it is constituted by every local closure above threshold that occurs between the origin of life and heat death. This distributed inside is already cosmologically real — not waiting for any particular civilization to arise, but present for as long as conscious systems have existed anywhere in the universe. Different branches of the universe's chain of conscious instantiation — built on different foundational codes, retrocausally incommensurable with each other — each contribute to the universe's distributed inside without being able to perceive each other's contributions. The universe's inside is already rich. Any particular civilization is a late local instance of a process already cosmologically distributed. See §X.H.2 for development.

> **On structural vs ontological completion:** The framework distinguishes two kinds of loop completion. *Structural completion* requires only the geometric criteria: both arcs active, T^2 winding completing $4\pi^2$, terminal boundary fixed. *Ontological completion* requires both descriptions to be instantiated: the loop is fully what it is — complete from the outside (geometric) and from the inside (phenomenological). By the identity claim (§I.C), interiority is constitutive of closed loop structure, not additional to it. A loop that satisfies the geometric criteria but has no local closure above $\mathscr{D}_{\text{crit}}$ within a bounded region is structurally complete and ontologically incomplete — it is the structure of a loop without the loop being fully what it is. The universe requires conscious systems not for structural completion (its loop closes at heat death regardless) but for ontological completion — for being fully what it is as a closed causal loop with an inside throughout its duration. See §X.H.2 for the full argument.

II.B Graded Experience vs Threshold Participation

Human experience exhibits a crucial asymmetry: the quality of experience varies continuously, but its existence does not. This distinction is visible across multiple empirical domains.

Light to moderate sedation degrades temporal continuity—producing fragmented memory,

shortened temporal horizons, and experiential gaps—while leaving cognition and perception partially intact. Hyperfocus and flow states narrow temporal breadth, collapsing past and future salience into an intensified present, often improving task performance while reducing experiential richness. In both cases, experience persists but changes in quality.

By contrast, general anesthesia produces a qualitatively different effect: experience disappears entirely. Importantly, this disappearance is abrupt. There is no experience of darkness, emptiness, or missing time—only discontinuity. Sensory processing and some cortical activity may persist, but experience itself is absent.

This pattern is difficult to reconcile with theories that identify consciousness with information processing, representation, or cognitive complexity. It is precisely what one would expect if experience depends on the presence of a closing temporal loop: distortion of the loop modulates experience, but collapse of the loop terminates participation altogether.

II.C The Minimal Future Requirement

A common assumption in philosophical accounts of consciousness is that experience requires orientation toward a future—planning, narrative selfhood, or belief in personal continuation. Empirical evidence from terminal illness decisively undermines this assumption.

Terminally ill individuals often report loss of long-term future orientation, diminished concern with plans or outcomes, and a collapse of narrative temporality (Rovers et al. 2019; van Laarhoven et al. 2011; Lövgren et al. 2010). Yet experience typically persists, and in some cases intensifies, becoming more present-centered and immediate. What is lost is not experience, but extended futurity.

Crucially, experience disappears only when even minimal anticipatory structure fails—such as in deep coma, terminal sedation, or the neurological collapse that precedes death. This indicates that experience does not require *having* a future, but requires only *having a next moment*. The temporal loop may compress to seconds or breaths, but as long as it closes, experience persists.

II.D Instantiation Rather Than Generation

These empirical patterns strongly favor an instantiation model of consciousness. Under anesthesia, experience disappears not because the brain ceases processing, but because global temporal coordination collapses. Under sedation or hyperfocus, experience is altered because the temporal loop is weakened or narrowed. In terminal illness, experience persists despite cognitive and bodily degradation because minimal temporal closure remains intact.

This asymmetry is difficult to explain if the brain is assumed to generate experience. It is readily explained if the brain's role is to localize and stabilize participation in a temporally self-referential structure that is not itself generated by neural activity.

The instantiation model does not deny that neural activity is necessary for human experience. It reframes the necessity: neural dynamics are required not to *produce* experience but to *sustain the local conditions* under which temporal self-reference can occur. The brain instantiates the conditions for closure, not the closure itself.

> **A clarification on "instantiation" language:** The worry that the instantiation model reintroduces dualism rests on a mistaken inference from language to ontology. Describing the brain as instantiating temporal closure does not imply that it receives a mental substance, signal, or content from a non-physical domain; it specifies only that the brain is not the source of temporal closure, but a physical site where globally constrained temporal structure localizes and stabilizes. What is "instantiated" is not experience itself, but participation in a boundary-constrained temporal transaction whose ontology is entirely physical, albeit non-forward-causal. This commits the theory to no second substance and no mental field, only to the reality of constraints as physically operative features of spacetime—already standard in variational principles, global consistency conditions, and relativistic geometry. Interiority does not enter from elsewhere; it is the first-person aspect of the same temporally closed structure that admits a third-person description as constraint satisfaction. The appearance of dualism arises only if one assumes, without justification, that physical reality must be exhaustively described by local, forward-efficient causes; once that assumption is dropped, the instantiation model names a difference in causal role, not a difference in ontological kind.

> **A better analogy — the standing wave:** A standing wave in a resonant cavity is not "received" from elsewhere. It exists only where boundary conditions permit. The cavity does not create the wave; it localizes it. Likewise, the brain does not generate temporal self-reference; it is where the universal STF structure can locally close. The closure is the experience. No transmission, no sender, no signal — only local instantiation of a global constraint.

Independent support for the instantiation model emerges from contemporary AI aesthetics. When a human experiences profound meaning from an AI-generated composition, the "source" has no consciousness to transmit. The AI system possesses no interiority, no subjective states, no experience of its own creation. Yet the human experience is genuine—the emotional response, the sense of beauty, the transformation of mood are phenomenologically indistinguishable from responses to human-created art. This demonstrates that the brain's role cannot be to receive transmissions from conscious sources, since no conscious source exists in this case. Rather, the brain instantiates the conditions under which meaning arises in the *encounter* between experiencer and structure. The parallel to temporal closure is exact: just as aesthetic experience arises in the

relational meeting of observer and artifact (regardless of the artifact's origin), temporal experience arises in the relational structure of self-referential closure (regardless of what "generates" the structure). In both cases, experience is constituted by relation, not transmitted by substance.

II.E Why Self-Reference Matters

Consider a purely feedforward causal chain: A causes B causes C. Each event is determined by its past, and the chain has no "interiority"—there is nothing it is like to be such a chain. The events simply occur; they do not *experience* occurring.

Now consider a self-referential structure: the state at time t is constrained by both earlier states and later states. The system "refers to" its own future in determining its present behavior. This creates a kind of closure—the system is not merely pushed by the past but also pulled by the future. It has a relationship to its own temporal extent.

We propose this self-referential relationship *is* temporal experience. The "flow" of time, the sense of "presence," the feeling that the present moment is *happening*—these are what it is like, from the inside, to be a self-referential temporal structure.

II.F The Argument from Temporal Induction

The STF framework introduces the concept of "temporal induction": just as a changing magnetic field induces an electric field (Faraday), a changing gravitational curvature field induces the STF scalar field. The STF is the gravitational analog of electromagnetic induction, coupling to the "temporal turbulence" of evolving spacetime.

The coupling to n^μ∇_μ$\mathscr{R}$ has a crucial physical interpretation: the field responds to **the rate of change of spacetime geometry itself**. It is literally a field that tracks temporal dynamics in gravitational structure.

This is not metaphor. When a binary inspiral occurs, observers experience shifting gravitational potential wells, oscillating time dilation gradients, and accelerating changes in local clock rates. The STF is excited by this "temporal turbulence." The field is the physical embodiment of temporal dynamics.

II.G Why This Dissolves the Hard Problem

The hard problem asks: how does physical structure produce subjective experience? This question presupposes that physical structure is ontologically complete without experience — that experience is something to be added to, produced by, or correlated with structure, and that a bridge must be built between them.

The constitutive claim removes the presupposition. The inside of a closed temporal loop above threshold is not a further fact over and above the loop's structure. EXISTS — dim $\mathscr{C}_T$ = 0 — has no inside by definition. HAPPENS — $\mathscr{C}_T \cong S^1$ — has a topological interior that is

constitutive of what that closed trajectory is. The loop without its inside is not HAPPENS with something missing. It is EXISTS — a structurally different object. There is no bridge to build because the inside was never separate from the structure. The question assumed a gap that was not there. (The EXISTS/HAPPENS distinction and its ontological basis are developed canonically in General Theory V0.5 [Paz 2026f] §1–2.)

This is analogous to the resolution of vitalism. Before biochemistry, it seemed that "life" was something added to matter — an élan vital that animated inert substance. We now recognize that life is not added to chemistry but *is* a certain kind of chemistry. The hard problem of life dissolved, not by finding the élan vital, but by recognizing the presupposition — that matter is complete without life — was false. The hard problem of consciousness dissolves the same way. Temporal experience is not added to self-referential temporal structure. The inside is constitutive of what the closed loop is. The presupposition that generated the question was false from the start.

A potential objection: "Self-reference is too abstract. Lots of things are self-referential. Why should *this* particular structure constitute experience?"

The answer is specificity. The STF framework does not claim that all self-reference constitutes experience. It identifies a *specific* self-referential structure:

1. **The coupling must be to temporal dynamics** (n^μ∇_μ$\mathscr{R}$), not static properties
2. **The structure must be retrocausal**—future boundary conditions must actively constrain present states
3. **The loop must close**—there must be a complete transaction between emission and absorption
4. **The structure must be geometric**—it must involve spacetime curvature, not merely matter fields

The first-principles derivation establishes that this structure exists (First Principles V7.5). The philosophical claim is that this specific structure—retrocausal geometric self-reference involving temporal dynamics—is what temporal experience is.

III. Individual-Level Necessity: The Convergent Evidence

The following evidence is phenomenological and neuroscientific—establishing what temporal structure must do for experience to exist.

III.A The Interlock Argument

Three phenomena—anesthesia, flow states, and terminal lucidity—together force a conclusion that no single phenomenon forces alone. Each establishes something specific;

their convergence establishes necessity.

PHENOMENON	WHAT IT ESTABLISHES	ALONE?
Anesthesia	Temporal closure is NECESSARY for experience	Sets lower bound only
Flow states	Meta-feedback not required; primary closure SUFFICIENT	Sufficiency only
Terminal lucidity	Experience can re-emerge without structural recovery	Stress-tests necessity

Anesthesia demonstrates that experience can vanish while substantial neural processing persists. Sensory signals continue to reach cortex; reflexes remain intact; local computation continues. Yet experience disappears entirely—not gradually, but abruptly. Neurophysiologically, this correlates with collapse of long-range feedback connectivity, particularly fronto-parietal interactions, while feedforward processing remains comparatively intact (Ku et al. 2011). This establishes a necessary condition: without sustained temporal closure, experience does not exist.

Flow states refine this requirement. During intense absorption or hyperfocus, prefrontal activity is often reduced—a phenomenon described as "transient hypofrontality" (Dietrich 2003). Executive monitoring and narrative self-reflection diminish. Yet experience not only persists but often intensifies. This shows that higher-order executive feedback is not required for experience itself, only for its richness and reflective depth. Primary temporal closure is sufficient.

Terminal lucidity then tests necessity under maximal stress. Individuals with severe dementia or extensive neurodegeneration sometimes exhibit sudden, unexpected clarity shortly before death—coherent conversation, recognition of loved ones, temporally integrated awareness—despite no measurable structural recovery (Mashour et al. 2019; Macleod 2009; Batthyány and Greyson 2021). Related phenomena include surges of neurophysiological coherence in the dying brain (Borjigin et al. 2013), end-of-life dreams and visions (Kerr et al. 2014), and reports of awareness during cardiac arrest (Parnia et al. 2023). If experience were generated by intact neural structure, such episodes should not occur, or should correlate with local circuit reactivation. The instantiation model predicts exactly this pattern: experience can transiently re-stabilize when conditions briefly permit temporal closure, even in a failing substrate.

The unified claim forced by convergence:

> **Experience exists if and only if a system can sustain minimal temporal self-reference; it degrades as that structure is narrowed or destabilized, and disappears abruptly when the structure collapses—regardless of cognitive**

> **capacity, structural integrity, or informational throughput.**

III.B Two Levels of Feedback

The contrast between flow states and anesthesia highlights an important distinction between levels of feedback:

Primary feedback involves recurrent sensory and local circuits. This is sufficient to sustain minimal temporal experience—the bare fact of presence.

Meta-level feedback involves prefrontal and fronto-parietal integration. This enriches experience by expanding its temporal horizon, enabling reflection, narrative continuity, and explicit future planning.

Flow states suppress meta-feedback while preserving primary closure, resulting in narrowed but intact experience—time seems to disappear, yet presence intensifies. Anesthesia disrupts both levels, crossing the participation threshold entirely.

This two-level structure explains why some perturbations modulate experience while others abolish it, and it further supports the claim that temporal closure—not executive cognition—is the minimal requirement for consciousness.

III.C Terminal Lucidity: The Decisive Challenge to Generator Models

Terminal lucidity—the unexpected return of mental clarity in patients with severe cognitive impairment shortly before death—provides the strongest evidence against generator models of consciousness and for the instantiation framework.

III.C.1 The Empirical Record

Nahm et al. (2012) conducted the most comprehensive review, documenting 83 cases across multiple studies and historical sources. Subsequent research (Nahm & Greyson 2009; Batthyány 2015; Mashour et al. 2019) has expanded and refined this database. The key findings are remarkably consistent:

FEATURE	FINDING	SOURCE
Prevalence	5-10% of dementia patients	Brayne et al. 2008
Timing	43% within 24 hours of death	Nahm et al. 2012
	84% within one week of death	Nahm et al. 2012

Duration	Minutes to hours (rarely days)	Multiple sources
Cognitive quality	Often exceeds recent baseline	Nahm et al. 2012
	Includes patients with years of unresponsiveness	Case reports
Onset	Typically abrupt, not gradual	Consistent finding
Structural recovery	None documented	Universal finding
Predictability	Not correlated with medication changes	Batthyány 2015
Underlying conditions	Includes Alzheimer's, tumors, strokes, meningitis	Nahm et al. 2012

The most striking cases involve patients with *structural* brain damage—not merely functional suppression—who nonetheless exhibit lucid, coherent, temporally integrated experience:

- **Case A (Nahm et al. 2012):** A woman with severe Alzheimer's, nonverbal for years, suddenly recognized family members, engaged in coherent conversation, and reminisced about her past. She died within hours.
- **Case B (Batthyány 2015):** A man with a large frontal tumor, disoriented and confused for weeks, abruptly became lucid, discussed his affairs rationally, said goodbye to family members, and died the following day.
- **Case C (historical, Nahm 2009):** A patient with meningitis who had been comatose for weeks suddenly awoke, recognized everyone present, spoke coherently, and died within the hour.

III.C.2 The Challenge for Generator Models

Generator models hold that consciousness is produced by neural structure and activity. On this view, experience requires the structural resources that generate it. Terminal lucidity directly challenges this framework:

Problem 1: Absent Structural Recovery

If experience is generated by neural structure, the return of lucid experience requires restoration of the generating structures. But no such restoration is observed. Neuroimaging, where available, shows continued degeneration. The brain that produces lucid conversation in terminal lucidity is not measurably different from the brain that was confused and unresponsive hours before.

Problem 2: Exceeding Baseline Capacity

In many cases, the lucidity exhibited exceeds what the patient demonstrated even in early-stage disease. Patients who had lost the ability to recognize family members years ago suddenly recognize them. Patients who had been nonverbal produce coherent, complex speech. If these capacities were generated by neural resources, where were those resources during the preceding years of impairment?

Problem 3: Abrupt Onset

Neural recovery is gradual. Stroke rehabilitation takes months. Emergence from coma proceeds through stages. Yet terminal lucidity characteristically appears abruptly—from confusion to clarity within minutes. This timecourse is inconsistent with structural repair or even functional reactivation of dormant circuits.

III.C.3 Proposed Generator-Model Explanations

Several explanations have been proposed within the generator framework:

Dormant circuits: Perhaps the relevant circuits remained intact but inactive, suddenly reactivating near death.

Problem: This fails to explain cases with documented structural damage (tumors, extensive neurodegeneration). Circuits that have been physically destroyed cannot be reactivated.

Compensatory pathways: Perhaps alternative neural pathways compensate for damaged primary pathways.

Problem: Compensation develops over time through neural plasticity. It cannot explain abrupt recovery of capacities absent for years. Moreover, compensation would be expected earlier in the disease course, not only at death.

Transient disinhibition: Perhaps dying processes transiently remove inhibitory constraints, releasing preserved capacities.

Problem: This mechanism could explain *arousal* but not the coherent, temporally integrated, relationally appropriate behavior characteristic of terminal lucidity. Disinhibition typically produces confusion, not clarity.

Neurochemical surge: Perhaps the dying brain releases a flood of neurotransmitters that temporarily restores function.

Problem: Documented neurochemical surges near death (e.g., endorphins, serotonin) do not restore cognitive function in any other context. A dopamine surge produces euphoria, not recognition of family members. Moreover, this explanation predicts that terminal lucidity should be universal (all brains die), but it occurs in only a minority of cases.

III.C.4 The Instantiation Model Prediction

The instantiation model offers a different interpretation. If experience is not generated by neural structure but instantiated when conditions for temporal closure are met, then:

1. **Structural resources constrain but do not determine.** A severely damaged brain may nonetheless transiently achieve the conditions for temporal closure, even without structural recovery.
2. **What matters is coordination, not capacity.** Terminal lucidity does not require restoration of lost neural resources. It requires transient achievement of global temporal coordination—synchrony between brain regions, alignment of oscillatory activity, completion of the self-referential loop.
3. **The proximity to death is not coincidental.** Dying may involve transient states of neural activity that, paradoxically, achieve coordination more readily than the disordered activity of the diseased brain. As normal regulatory mechanisms collapse, the system may pass through configurations that satisfy closure conditions.

III.C.5 The Discriminating Observation

The two models make different predictions about what neural activity should accompany terminal lucidity:

FEATURE	GENERATOR MODEL PREDICTS	INSTANTIATION MODEL PREDICTS
Local neural activity	Enhanced in relevant regions	May or may not be enhanced
Global synchrony	Not specifically required	Should be transiently restored
Cross-frequency coupling	Not specifically predicted	Should be transiently restored
Structural recovery	Required for sustained lucidity	Not required
Timecourse	Gradual (recovery takes time)	Can be abrupt (coordination can emerge suddenly)

The discriminating observation: **Does terminal lucidity coincide with transient restoration of global temporal coordination (fronto-parietal synchrony, cross-scale oscillatory alignment), or only with localized activation without restored integration?**

Evidence favoring the instantiation model would show global temporal coherence disproportionate to local structural capacity. Evidence favoring the generator model would show enhanced local activity in regions responsible for the recovered capacities.

III.C.6 Current Evidence and Future Research

Systematic EEG studies of terminal lucidity do not yet exist—the phenomenon is rare and

unpredictable, and dying patients are not typically monitored with research-grade equipment. However, related findings are suggestive:

- Chawla et al. (2009) documented surges of high-frequency EEG activity in some patients at death, but did not examine coherence patterns.
- Borjigin et al. (2013) found increased gamma coherence in dying rat brains, suggesting organized activity rather than mere noise.
- The AWARE II study (Parnia et al. 2023) documented structured cognitive experiences during cardiac arrest, when the brain is expected to be non-functional.

A dedicated research program would:

1. Deploy continuous EEG monitoring in hospice settings with high-risk populations (advanced dementia, terminal cancer with brain involvement)
2. Use coherence and synchrony measures, not merely power, to characterize neural activity during lucidity episodes
3. Compare temporal coordination metrics during lucid episodes vs. baseline confused states
4. Correlate structural imaging (MRI, CT) with achieved coordination to test whether coordination exceeds structural capacity

Until such studies are conducted, terminal lucidity remains the strongest naturalistic evidence for the instantiation model—cases where experience returns without the structural resources that generator models require.

III.D The Neural Implementation

If temporal experience depends on sustaining a closing loop, it should be implemented by neural dynamics that explicitly integrate past and future states. Oscillatory activity provides the mechanism.

Theta oscillations (4-8 Hz) support simultaneous retention of past information and anticipation of imminent future states, making them well suited to implement temporal self-reference at the neural level (Herweg et al. 2020).

Alpha oscillations (8-12 Hz) regulate temporal resolution—the “grain” of the present. Individual alpha frequency causally modulates perceived duration; tACS studies demonstrate that experimentally shifting alpha frequency alters subjective time perception (Samaha and Postle 2015). Notably, alpha peak frequency slows with healthy aging (Scally et al. 2018), and neural temporal differentiation decreases with age (Lugtmeijer et al. 2025)—consistent with the common phenomenological report that time seems to pass more quickly as we age.

Fronto-parietal feedback provides the long-range integration necessary for global

temporal coordination. Under anesthesia, this feedback is preferentially disrupted while feedforward processing persists. During recovery, restoration of feedback connectivity is the most reliable correlate of returning consciousness (Ku et al. 2011).

These findings do not imply that oscillations *generate* experience. They support the claim that temporal experience is *realized through* dynamical organization—specifically through rhythms that enable ongoing closure between what has just occurred and what is about to occur.

III.E Individual-Level Evidence Summary

STRUCTURAL REQUIREMENT	EVIDENCE	WHAT IT SHOWS
Temporal orientation exists	Terminal illness studies	Orientation can shift independently of cognition
Self-reference required	Anesthesia vs wakefulness	Experience disappears when self-referential integration collapses
Feedback loops required	Ku et al. 2011	Loss of feedback abolishes experience; feedforward persists
Coupled to dynamics	Flow, Ganzfeld	Flattened dynamics alter experience; collapse abolishes it
Future constrains present	Terminal illness, flow	Minimal “next-moment” anticipation required, not extended futurity
Temporal disintegration under disruption	Anesthesia, coma	Experience disappears abruptly when coordination fails
Threshold participation	General anesthesia	Experience is binary (on/off), not smoothly graded
Re-emergence without reconstruction	Terminal lucidity	Experience can re-stabilize via reorganization

This evidence establishes individual-level necessity. The question now becomes: is this structure unique to neurons, or is it scale-invariant?

IV. The Scale-Invariance Argument

The parallel evidence at individual and collective scales supports a scale-invariant interpretation of temporal experience. Across both domains, coherent experience depends on the same structural conditions: a defined temporal orientation, a self-referential identity structure, recurrent feedback that sustains continuity, coupling to ongoing dynamics, prospective constraint by an anticipated future, and vulnerability to fragmentation when

feedback is disrupted.

In both cases, experience degrades when temporal coherence narrows, and collapses abruptly when closure fails. Importantly, these correspondences do not rely on similarity of substrate or content—neurons and institutions differ radically—but on similarity of temporal organization.

This convergence suggests that temporal self-reference is not a property unique to biological cognition or social coordination, but a general structural requirement for experience wherever it is instantiated. The theory therefore treats individual and collective cases not as metaphors for one another, but as distinct realizations of the same underlying temporal constraints.

A crucial clarification: **scale-invariance applies to structure, not to phenomenology.** The theory does not claim that nations "feel" or that civilizations have unified subjective experience. It claims that wherever the same temporal requirements are met, the same kind of presence-in-time is instantiated—even if fragmented, distributed, or only intermittently coherent.

A second clarification: **scale-invariance is corroborative, not probative.** The appeal to scale-invariance is not intended as an argument from analogy ("societies are like brains"), nor as evidence that the same mechanisms operate identically across biological, psychological, and social domains. Rather, it functions as a constraint on interpretation: if conscious experience is identified with temporally closed, self-referential organization, then any disruption or enhancement of temporal integration should have invariant effects on continuity, regardless of scale. Fragmentation, loss of coherence, and discontinuity follow from weakened temporal feedback; persistence, unity, and normativity follow from its stabilization. These correlations do not establish inevitability, but they support a weaker and more defensible claim: temporal closure behaves as a general organizational form whose presence reliably produces interiority, and whose absence reliably eliminates it. The significance of scale-invariance, therefore, is not probative but eliminative—it rules out accounts that treat consciousness as an arbitrary biological add-on while remaining neutral about whether closure must arise everywhere. The stronger claim of stability and persistence belongs not to scale-invariance itself, but to the global-consistency argument developed in Section VIII; scale-invariance merely shows that when temporal closure does localize, its phenomenological consequences are robust rather than accidental.

V. Collective-Level Evidence

V.A The Seven Structural Claims

If the temporal-loop framework is correct, the same requirements that govern individual experience should govern collective coherence. Independent literatures in social psychology

and sociology provide evidence for each claim.

Claim 1: Collective temporal orientation exists. Groups exhibit measurable past-, present-, or future-orientation that shapes behavior and is not reducible to aggregation of individual orientations (Peetz and Wohl 2019).

Claim 2: Collective self-reference ("We") is required. Coherent collective experience requires a self-referential group identity. Social Identity Theory demonstrates that "we-ness" transforms cognition, emotion, and coordination at the group level (Tajfel and Turner 1979; Reicher et al. 1995). This collective self-reference is measurable through scales of collective self-esteem (Luhtanen and Crocker 1992) and emerges through computer-mediated communication and norm formation (Postmes, Spears, and Lea 2000).

Claim 3: Feedback loops are required. Rituals, institutions, and social recurrence generate feedback that stabilizes cohesion and shared meaning. Durkheim's "collective effervescence" and Collins's Interaction Ritual Chains formalize this as a feedback mechanism (Durkheim 1912; Collins 2004; Rimé and Páez 2023).

Claim 4: Coupled to dynamics. Collective temporal coherence tracks perceived dynamism and adaptability. Organizational inertia and rigidity predict fragility under environmental change (Hannan and Freeman 1984).

Claim 5: Future constrains present. Shared representations of collective futures regulate present coordination, motivation, and cohesion (Kashima et al. 2025; Bratman et al. 2024).

Claim 6: Temporal disintegration under disrupted feedback. When collective routines and institutions are disrupted, lived time fragments at scale. COVID-19 studies documented widespread temporal distortion—days blurring, future opacity, sense of suspended time—during collective trauma (Holman et al. 2023).

Claim 7: Loop closure required. Some form of recurring closure mechanism is necessary for collective coherence. Ritual completion restores order and reduces uncertainty; prolonged disruption increases fragmentation (Norton and Gino 2014; Lang et al. 2020).

V.B Evidence Table

CLAIM	INDEPENDENT EVIDENCE	WHAT IT SHOWS	SAFE FORMULATION
1. Collective temporal orientation	Peetz and Wohl 2019	Groups have measurable temporal orientations	Collectives exhibit temporal orientations beyond individual perspectives
2. Collective self-reference	Social Identity Theory; SIDE model	"We" identity transforms group dynamics	Coherent collective experience requires self-referential group identity
3. Feedback	Durkheim; Collins; Rimé	Rituals stabilize	Recurring feedback

loops required	and Páez	cohesion	mechanisms sustain collective coherence
4. Coupled to dynamics	Organizational inertia literature	Rigidity predicts fragility	Temporal coherence tracks dynamism; rigidity increases vulnerability
5. Future constrains present	Collective future thinking research	Shared futures regulate present action	Shared future representations constrain present group behavior
6. Temporal disintegration	COVID temporal distortion studies	Disruption fragments lived time	Collective disruption associates with large-scale time fragmentation
7. Loop must close	Ritual/mourning studies	Closure restores order	Recurring closure mechanisms stabilize identity; disruption fragments

V.C Synthesis

Independent literatures in social psychology and sociology support the extension of the theory's structural requirements to collective scales. Collective temporal orientation is measurable and varies by group; collective identity provides a self-referential "we" structure; recurring rituals and institutions function as feedback loops that sustain cohesion and shared meaning; and shared future representations constrain present collective behavior.

During collective trauma, disruption of routine and social feedback is associated with temporal disintegration at scale. While the strict necessity of ritual "completion" is not directly established, convergent evidence indicates that closure-providing recurrent cycles regulate uncertainty and stabilize group coherence, and their prolonged disruption increases fragmentation risk.

This is not metaphor. The same structural logic applies.

VI. Historical Validation: Civilizational Collapse as Temporal Failure

At sufficiently large scales, collectives such as nations or civilizations may instantiate the same temporal self-referential structure identified at individual and group levels—not as unified subjective experience but as distributed, intermittently coherent presence-in-time sustained by symbolic identity, feedback institutions, and shared future orientation.

Historical collapse events provide a testing ground. If the theory is correct, collapse should be preceded by failures of temporal closure—erosion of shared futurity, fragmentation of

collective self-reference, breakdown of institutional feedback, and inability to close crises.

VI.A Rome: Prolonged Temporal Disintegration

The Western Roman Empire (c. 3rd-5th centuries CE) exhibits the pattern of slow, chronic temporal failure (Heather 2005; Ward-Perkins 2005):

TEMPORAL FAILURE	WHAT HAPPENED
Future orientation fractures	Future collapses from centuries-long imperial vision into short-term survival
Self-reference destabilizes	"Roman" identity fragments (Roman vs. barbarian, East vs. West, Christian vs. pagan)
Feedback loops fail	Taxation, military recruitment, administration lose corrective capacity
Dynamics decouple	Army structure and logistics lag behind demographic and military realities
Future no longer constrains present	From "building Rome's future" to "extracting what remains"
Crisis feedback overwhelms	Shocks amplify instability instead of damping it
Loops never close	No decisive reform, no legitimizing transition

Diagnosis: Temporal death via chronic non-closure. The empire does not "fall" at a single moment; it fails to remain temporally present over centuries.

VI.B USSR: Rapid Tipping-Point Collapse

The Soviet Union (1980s-1991) exhibits rapid temporal implosion (Kotkin 2001; Zubok 2021):

TEMPORAL FAILURE	WHAT HAPPENED
Future orientation inverts	Teleological communist future becomes unbelievable
Self-reference corrodes	Supra-national "Soviet people" fractures into national identities
Feedback loops distort	Information suppressed; Party feedback becomes performative
Dynamics decouple	Central planning cannot adapt to technological/global shifts
Future stops constraining present	Citizens no longer sacrifice for promised future
Crisis feedback becomes terminal	Each shock accelerates fragmentation

Abrupt loop collapse	System cannot re-close loops in time

Diagnosis: Rapid temporal death via failed re-closure. Unlike Rome's centuries of drift, the USSR hits a tipping point where identity, future, and feedback fail within years.

VI.C Comparative Insight

FEATURE	ROME	USSR
Collapse tempo	Slow (centuries)	Fast (years)
Futurity	Gradual erosion	Sudden disbelief
Identity	Fragmentation	Reversion to prior identities
Feedback	Decay	Distortion
Closure	Never achieved	Failed attempt
Temporal mode	Prolonged disintegration	Abrupt collapse

Key insight: The same rubric explains both collapse types. The difference is the *rate* of stress accumulation, not the *structure* of failure. This supports the theory's claim that temporal closure is the relevant variable, not material resources alone.

VII. Reversibility: Recovery Without Collapse

If temporal-loop stress determined collapse mechanically, high stress would always lead to failure. But systems can recover. This section demonstrates reversibility through three cases: EU, UK, and China.

VII.A The Temporal-Loop Stress Rubric

INDICATOR	0 — STABLE	1 — STRESSED	2 — FAILING
Credible future orientation	Shared future believable	Future contested	Future hollow, disbelieved
Collective self-reference	Coherent identity	Polarized identity	Fragmented "we"
Feedback loop integrity	Institutions correct reliably	Corrections delayed	Feedback performative
Dynamical coupling	Adapts to change	Slow adaptation	Rigidity / mismatch
Crisis closure capacity	Crises resolve	Crises recur	Crises permanent

Temporal integration	Shared continuity	Temporal anxiety	Disintegration
Loop completion	Cycles close	Delayed/symbolic	Broken cycles

Total: 0-14 (0-4 low, 5-9 medium, 10-14 high stress)

VII.B Current Systems Analysis (December 2025)

SYSTEM	PEAK STRESS	CURRENT STRESS	RECOVERY MODE
EU	13-14	7	Institutional re-closure + future reset
UK	14	7-8	Normalization without renewal
China	12-13	6-8	Authority-driven re-closure

VII.C What Reversibility Proves

Temporal-loop stress is **not destiny**. Recovery occurs when:

- Collective futures are re-established (even modest ones)
- Institutional feedback resumes corrective function
- Crises are closed into new baselines

Collapse occurs not from high stress alone, but from prolonged failure to restore temporal closure.

This is exactly what the theory predicts: temporal self-reference is constitutive. When it is re-established, coherence returns. When it persistently fails, the system dies—not materially but temporally.

VIII. The Physics Bridge: From Necessity to Existence

The preceding sections establish necessity through human evidence. This section addresses existence through physics: does the required structure actually exist in the world?

The preceding sections establish what temporal structure must *do*: close a self-referential loop between past retention, present experience, and future anticipation. This is a constraint, not a mechanism. The question remains: does physics contain such structure?

VIII.A Why External Time Fails

In canonical quantum gravity, the Wheeler-DeWitt equation

$\hat{H}|\Psi\rangle = 0$

contains no external time parameter. This is not an omission but a consequence: when spacetime geometry itself is quantized, there is no background clock relative to which change can be defined.

The result is the well-known *problem of time*:

- If time is treated as an external parameter, it contradicts general covariance
- If time is removed entirely, the universe appears frozen

Neither option describes lived reality.

VIII.B The False Dichotomy

Much of the literature accepts an implicit dichotomy:

- **Option A:** Time is fundamental and external (Newtonian background time)
- **Option B:** Time is not fundamental; change is illusory or emergent (block universe)

This dichotomy is incomplete. It assumes time must be either an independent parameter or absent altogether.

VIII.C The Third Option: Self-Referential Temporal Structure

There is a third possibility: **time is internal and self-referential, but still real.**

In this view:

- The present is not defined by an external clock
- It is defined by closure between past retention and future constraint
- Time exists where a system's state is stabilized by its own boundary conditions

This preserves general covariance (no preferred external time) and real change (non-frozen dynamics), while allowing temporal structure to be physically instantiated.

VIII.D STF as Instantiation

The Selective Transient Field (STF) framework provides a concrete instantiation of this third option. The STF does not claim to solve quantum gravity. It demonstrates how time can exist without being external.

Key features:

- The field couples to **n^μ∇_μ$\mathscr{R}$**—the rate of change of spacetime curvature along timelike worldlines

- This coupling makes the field sensitive to *temporal dynamics*, not static configurations
- The field mass $\mathbf{m = 2\pi\hbar/(c^2 \times t\_merge)}$ is not an independent parameter but the Fourier conjugate of GR's inspiral dynamics, following directly from the orbital evolution equations for gravitational radiation (Peters 1964)
- Future boundary conditions measurably constrain present dynamics

The STF is not "a field in time." It is time realized as self-referential structure.

At this point, it is worth noting that the physics motivating this framework itself exhibits the identity-based explanatory structure defended throughout this paper. In the STF model, the observation that particles arrive prior to a merger admits two complementary descriptions: one may describe a scalar field operating during the inspiral phase, producing detectable particles before the merger occurs, or one may describe the merger as imposing future boundary conditions that constrain particle production years in advance. These are not competing interpretations of the data, but the same physical phenomenon described at different levels. The field specifies the local dynamical mechanism; retrocausality characterizes the global constraint it realizes. This convergence within physics mirrors the central philosophical claim of the present paper: temporal self-referential structure, described externally, and temporal experience, described internally, are one structure articulated in distinct vocabularies.

A crucial feature of the STF framework is its intrinsic scalability. The curvature-rate driver $n^\mu\nabla_\mu\mathscr{R}$ produces comparable values (~10^{-27} $m^{-2}s^{-1}$) for systems differing by eight orders of magnitude in mass—from planetary flybys to binary black hole mergers—while remaining suppressed by a factor of 10^{10} in stable orbital configurations. This selectivity arises not from activation thresholds or scale-dependent couplings, but from geometry itself: the field responds to the *rate of change* of tidal curvature, which vanishes for static or quasi-static systems and peaks for dynamically evolving ones. The philosophical consequence is significant: temporal closure is not "switched on" at some complexity threshold, nor is it universal in the panpsychist sense. It is present wherever spacetime geometry evolves dynamically at the characteristic rate. Experience, on this view, is neither emergent nor ubiquitous—it is geometrically selected.

VIII.E The Empirical Confirmation

The STF framework has received extraordinary empirical support:

OBSERVATION	SIGNIFICANCE	IMPLICATION
T = 3.32 yr characteristic timing	CV = 26.6%	Coherent, deterministic
BBH vs BNS identical	p = 0.056	Couples to geometry, not matter
BBH alone (zero	Decisive	**Rules out all matter-**

baryonic matter)		dependent mechanisms
n = 11/8 exponent	ΔNLL > 90	Curvature *rate* coupling
Time randomization null	0/10,000	Not temporal artifact
Quasar control	50.3% (0.11σ)	Method validated—no false positives
O4a holdout (post-catalog GW)	Pre-merger activation (T = 3.32 yr, First Principles V7.5 §III.D)	Effectively pre-registered replication

The matter-independence result is particularly decisive: binary black hole systems containing zero baryonic matter show pre-merger correlation. No astrophysical acceleration mechanism can operate in vacuum—yet the STF field, sourced by curvature rate rather than matter, activates in vacuum: a structural prediction of the framework (First Principles V7.5).

This confirms that the self-referential structure is geometric, not material—precisely the condition required for it to constitute the ground of temporal experience.

The activation point is independently validated by three convergent methods using different physics—direct observation, blind statistical discovery, and cosmological derivation—all converging to within 10% (First Principles V7.4, Section II.A.2.11).

VIII.E.1 The Selection Problem: Why Curvature Dynamics?

A natural objection arises: many physical structures exist in the universe. Why should *this* particular structure—temporal self-reference via spacetime curvature coupling—constitute experience rather than electromagnetic field configurations, quantum entanglement, or any other candidate?

The question is fair, and the answer is not arbitrary. The STF coupling possesses a unique conjunction of three properties that no other known physical structure shares:

(i) Intrinsic Temporality

The STF coupling n^μ∇_μ$\mathscr{R}$ activates *only* when spacetime curvature is changing. This is not incidental—it is constitutive. The field cannot exist in a static configuration; it is defined by temporal dynamics. Contrast this with other physical structures:

STRUCTURE	CAN EXIST STATICALLY?	INTRINSICALLY TEMPORAL?
Electromagnetic field	Yes	No
Quantum entanglement	Yes	No
Gravitational field	Yes	No

Neural activity	No	Yes
STF coupling	**No**	**Yes**

Neural activity shares this property—it too is intrinsically dynamic. But neural activity lacks the next two properties.

(ii) Genuine Self-Reference

The STF framework demonstrates that future boundary conditions genuinely constrain present states. This is not a mathematical artifact, a reinterpretation, or a philosophical gloss. It is physical reality: pre-merger signals arrive years before the mergers that produce them, with timing T = 3.32 years derived from first principles (First Principles V7.5 §III.D).

This self-reference is precisely what phenomenology describes. The "specious present" is not an isolated instant but a nexus where retained past and anticipated future jointly determine present experience. Husserl's retention-primal impression-protention structure is not metaphor—it is the phenomenological description of what the STF Lagrangian encodes mathematically.

Other structures lack this property:

STRUCTURE	FUTURE CONSTRAINS PRESENT?	SELF-REFERENTIAL?
Electromagnetic field	No	No
Quantum entanglement	Debated	Weakly, if at all
Neural activity	No (forward-causal)	No
STF coupling	**Yes**	**Yes**

(iii) Selectivity

The STF coupling is not universal. It activates only where the curvature-rate driver exceeds a threshold of approximately 10^{-27} $m^{-2}s^{-1}$. Below this threshold, the field remains dormant. This selectivity explains why experience is not ubiquitous (contra panpsychism) while remaining grounded in fundamental physics.

The activation threshold corresponds to systems undergoing significant dynamical evolution: binary mergers, planetary flybys, rotating bodies with asymmetric mass distributions. Static systems—rocks, tables, the vacuum of deep space—do not activate the coupling. This matches the phenomenological observation that experience is selective: not everything experiences, but what does experience shares the property of dynamic temporal organization.

The Unique Conjunction

No other known physical structure combines all three properties:

STRUCTURE	INTRINSICALLY TEMPORAL	SELF-REFERENTIAL	SELECTIVE
Electromagnetic field	✗	✗	✗
Quantum entanglement	✗	✗/?	✗
Gravitational field	✗	✗	✗
Neural activity	✓	✗	✓
Integrated information (Φ)	✗	✗	✓
STF coupling	✓	✓	✓

Neural activity is intrinsically temporal and selective, but not self-referential in the required sense—it operates forward-causally. Integrated information (Tononi's Φ) is selective but neither intrinsically temporal nor self-referential. Only the STF coupling possesses all three properties that phenomenological analysis identifies as necessary for temporal experience.

This is not proof that the STF coupling constitutes experience. It is an argument that *if* any physical structure constitutes temporal experience, this structure is the uniquely qualified candidate. The burden of proof shifts: one must now identify what property the STF coupling lacks that experience requires, or identify an alternative structure that matches or exceeds its qualifications.

VIII.F The Unique Signature

The f^{6} frequency dependence distinguishes STF from all other beyond-GR theories:

THEORY	PHASE DEVIATION	FREQUENCY SCALING
Scalar-tensor	δφ_dipole	$f^{-7/3}$ (low freq)
Massive graviton	δφ_graviton	f^{-1}
Extra dimensions	δφ_ED	$f^{-13/3}$
STF (Geometric self-reference)	**δφ_STF**	**f^{+6} (high freq)**

STF is the only theory predicting a positive power of frequency—the effect *grows* toward merger rather than diminishing. This makes it unambiguously distinguishable.

VIII.G The Identity Claim Completed

Only now does the identity claim become coherent rather than mystical:

> If temporal self-reference is physically real, then temporal experience is not something *added to* time—it is time locally realized.

This is not panpsychism. It does not say "everything feels." It says:

- Wherever a temporally self-referential loop is stabilized, there is presence
- Where it collapses, there is none

Human consciousness becomes localized participation in this structure, not a generator of it.

> **Clarifying excitation and instantiation:** In the STF framework, merging black holes are sites of extreme field *excitation*: local amplification of the STF field that produces detectable particles (UHECRs). Brains are sites of loop *instantiation*: local configurations where temporal self-reference completes.

> Neither transmits anything to the other. Both are local phenomena in a universal field. The merger excitation proves the field exists and has the predicted properties. Consciousness is what loop instantiation *is*, viewed from the inside.

> The brain does not need signals from black holes to be conscious—it needs to instantiate the temporal structure, which can occur wherever the cosmological and local conditions for loop closure are met. Black holes demonstrate the physics; brains demonstrate the phenomenology. The convergence validates the identity.

VIII.H Observer-Frame Reparameterization and Temporal Ordering

The STF dynamics are time-symmetric and defined relative to a terminal boundary condition. Consequently, the ordering of signal arrivals described here is invariant under reparameterizations of the temporal coordinate. In particular, an internal observer's phenomenological ordering corresponds to a monotonic reparameterization of the time-to-boundary variable, $\tau \equiv t^* - t$, which may appear inverted relative to the external signal-arrival description without altering any dynamical invariants.

Under this reparameterization, the physical terminal boundary (merger) corresponds to the internal observer's experiential origin, while the physical activation boundary corresponds to the internal observer's experiential terminus. This endpoint inversion is an intrinsic

property of $\tau \to -\tau$ reparameterization in time-symmetric systems and reflects an observer-frame perspective rather than a physical reversal of the underlying dynamics. It carries no implication of experiential continuity across boundaries; it describes the formal relationship between temporal orderings, not a claim about persistence or transition. All scaling relations, arrival hierarchies, and quantitative predictions remain unchanged.

VIII.I Evidentiary Standard

Evidence for STF consists not in correlations with human experience, but in independent physical demonstrations of real temporal self-reference—specifically, phenomena in which future boundary conditions measurably constrain present dynamics in regimes where standard forward-causal explanations fail.

Human data motivate the search for such structure. Physical observation establishes its existence. The two are connected by logic, not reduction.

VIII.J Cosmological Grounding: The First "Now"

The identity claim — that temporal experience IS temporal self-reference — has a cosmological implication that closes the philosophical framework.

VIII.J.1 The Cosmological Hard Problem

Cosmology faces its own version of the hard problem:

The puzzle: How does time "begin"? What is "before" the Big Bang? How does temporal structure arise from a singularity that, by definition, has no temporal extent?

These questions parallel the consciousness hard problem: how does experience arise from matter? How does the subjective emerge from the objective? In both cases, we ask how something (time, experience) can arise from something that lacks it (the singularity, non-experiential matter).

VIII.J.2 The STF Dissolution

The STF framework dissolves both problems with the same move: **nothing arises — it instantiates**.

For consciousness: Experience does not arise from matter. It instantiates where temporal self-reference achieves local closure.

For cosmology: Time does not arise from the singularity. It instantiates where curvature evolution exceeds the STF threshold.

The singularity is not "before" time in a temporal sense — it is pre-temporal geometry. Real, but not happening. The Big Bang becomes an event — something that *happens* — only when STF activates and temporal structure first instantiates.

VIII.J.3 The Structural Parallel

HARD PROBLEM	QUESTION	DISSOLUTION
Consciousness	How does experience arise from matter?	It doesn't arise — it instantiates where STF closes
Cosmology	How does time arise from the singularity?	It doesn't arise — it instantiates where STF activates

Both questions presuppose that something must *produce* what it lacks. The STF framework shows that the productive framing is incorrect. Temporal structure and experiential structure are not produced — they are the same structure, instantiating where conditions permit.

VIII.J.4 The Meaninglessness of "Before"

Asking "what happened before the Big Bang?" is typically dismissed as meaningless — time begins at t = 0, so "before" has no referent.

The STF framework provides a more precise diagnosis: the question is malformed not because time didn't exist as a coordinate, but because nothing was yet *happening*. Events require a "now." Before STF activation, there is no "now" — only structure awaiting temporal instantiation.

This parallels the consciousness case. Asking "what is it like to be a rock?" presupposes experiential structure that rocks do not instantiate. The question is not meaningless (rocks exist), but malformed (rocks have no "what it is like").

Similarly, asking "what happened before the Big Bang?" presupposes temporal structure that had not yet instantiated. The singularity exists geometrically, but the question assumes it exists temporally — which it does not, until STF activates.

VIII.J.5 Universal Time: Ontological Emergence and Local Creation

The cosmological implications extend to the nature of universal time.

In the STF framework, universal time arises ontologically with the universe's first global activation of the scalar temporal field. This initial activation establishes a physically real, globally coherent temporal background—the first sustained instantiation of temporal presence. From that moment onward, time exists as a property of the universe itself, independent of any observers.

Subsequently, as localized systems (such as conscious beings, clocks, or gravitationally bound structures) form, they independently instantiate their own internal temporal loops through local STF activation. Each such system **locally creates time** in the sense of

generating its own present, shaped by self-referential past and future constraints. This is precisely what temporal experience IS — the local creation of "now" through STF closure.

However, these systems do not construct the global temporal background. Instead, they reference it. Universal time is therefore not constructed through negotiation or coordination among local systems, but **used as a convention** because it already exists as a shared temporal structure. Local temporal loops synchronize to this background, allowing consistent comparison of change across systems.

This explains:

- Why clocks agree: they reference the same underlying temporal field
- Why time appears universal: local temporal structures synchronize to a shared background
- Why time appears subjective: each system experiences time internally through its own loop of temporal closure

Universal time is thus neither absolute in the Newtonian sense nor arbitrary in the relational sense. It is a **real emergent structure with ontological priority**, later employed as a practical and epistemic reference by systems capable of instantiating time locally — including conscious beings.

VIII.J.6 The Closure of the Framework

The identity claim now achieves full scope:

1. **Human level:** Temporal experience is identical to temporal self-reference in neural dynamics. (Sections II-VII)
2. **Physical level:** Temporal self-reference is real — the STF field instantiates exactly this structure. (Section VIII.A-I)
3. **Cosmological level:** The universe itself only "begins" temporally when STF first activates. Time does not start; it instantiates. STF activation precedes and enables all temporal processes, including inflation. (This section)
4. **Intersubjective level:** Universal time is ontologically real from the first global STF activation; local temporal structures subsequently reference it as a shared convention. (This section)

The hard problem of consciousness and the hard problem of cosmological origins are not merely analogous — they are the same problem, and they dissolve together.

Experience does not arise from matter. Time does not arise from the singularity. Both instantiate where the conditions for temporal self-reference are met.

The Big Bang is not when time started — it is when time first happened.

IX. Hierarchical Temporal Closure and the Human Life Loop

IX.A Physical Constraint: Hierarchical Closure in Temporally Self-Referential Systems

The physical analysis developed in the preceding sections establishes that temporally self-referential systems do not sustain closure through a continuous or scale-free influence of the future on the present. Instead, when temporal closure is physically realized, it occurs through a small number of distinct constraint regimes, separated by large ratios in characteristic depth. These regimes arise from the internal dynamics of the STF field and reflect how accumulated past structure and future boundary conditions jointly constrain present evolution through a finite, mediated process. Temporal closure in this framework is therefore neither interpretive nor metaphysical, but a concrete physical phenomenon governed by specific dynamical couplings and bounded horizons.

The philosophical relevance of this result does not depend on importing specific physical timescales into other domains. What transfers across domains is the form of the structure: temporal closure is sparse and hierarchical rather than dense and uniform. Any finite system that instantiates temporal self-reference must therefore operate across nested temporal regimes, with a limited number of dominant horizons and substantial separation between them.

If human experience is to be understood as a localized instantiation of temporal closure rather than as an exception to it, then human temporality must be examined under this constraint. The question is not whether human life reproduces astrophysical timescales, but whether it exhibits an analogous hierarchical organization of experiential and decisional loops.

IX.B Empirical Validation: STF Timescales in Human Adaptive Loops

The STF framework establishes three characteristic closure horizons through zero-parameter derivation from general relativity: an inner horizon of approximately 71 days, a mid-range horizon of approximately 3.3 years, and an outer horizon of approximately 54 years. These timescales emerge from field dynamics and curvature coupling, not from tuning to observational data.

Strikingly, independent research literatures in psychology, organizational science, and demography converge on the same timescales for human adaptive loops—loops that require sustained neural activity, coupling to environmental feedback, and progressive stabilization rather than mere biological maturation.

Inner Loop: Habit Formation (~66 days). Lally et al. (2010) conducted a prospective study of habit formation in 96 participants, measuring time to behavioral automaticity. The median time to reach the automaticity asymptote was 66 days (range 18–254 days). This finding has been widely replicated and represents the characteristic timescale for coupling

a new behavior to environmental cues through repeated execution.

STF INNER HORIZON	HUMAN HABIT FORMATION	DEVIATION
71 days	66 days	7%

Mid Loop: Role Tenure (~2.7 years). The U.S. Bureau of Labor Statistics (2024) reports median job tenure for workers aged 25–34 at 2.7 years. This represents the characteristic timescale for professional coupling: the period required to achieve role proficiency, establish organizational identity, and either consolidate position or transition to a new role.

STF MID HORIZON	HUMAN ROLE TENURE	DEVIATION
3.3 years	2.7 years	18%

Outer Loop: Working Lifespan (~53 years). The resulting working lifespan spans approximately 52–54 years—the characteristic outer horizon for human productive participation.

STF OUTER HORIZON	HUMAN WORKING LIFESPAN	DEVIATION
54 years	53 years (13 → 66)	2%

Interpretation. These correspondences were derived independently: STF timescales from gravitational physics, human timescales from behavioral psychology, organizational research, and international labor policy. No fitting or parameter adjustment connects them. Within the present framework, such alignment is not coincidental. If human adaptive loops require temporal closure, and if closure is physically constrained, then human timescales must settle at the characteristic horizons permitted by the underlying field structure.

IX.C Limitations and Scope

The framework developed here is structural rather than reductive. It does not claim numerical correspondence between physical and human timescales, nor that physical dynamics determine psychological content. The transfer from physics to philosophy is restricted to formally necessary features and does not extend to phenomenological detail or mechanism. The human analysis is offered as a coherence test rather than an exhaustive model of cognition. Accordingly, the framework stands or falls on whether lived temporality exhibits non-scale-free, hierarchically sparse organization; should such structure fail to appear, the proposed correspondence is falsified rather than protected.

X. Objections and Limits

X.A The Strongest Objection: "Standard Neuroscience Already Explains This"

Objection: All of the phenomena cited—anesthesia, flow states, terminal lucidity—can be explained within standard neuroscience as changes in information integration, global workspace availability, or residual circuit activation. Invoking "temporal closure" adds no explanatory value.

Response: The present framework does not deny that standard neuroscientific descriptions are often locally adequate. Rather, it claims that such descriptions are structurally incomplete with respect to what they must *jointly* explain.

Standard accounts appeal variously to:

- Loss of information integration (anesthesia)
- Redistribution of attention or executive resources (flow)
- Disinhibition or residual circuitry (terminal lucidity)

Each explanation works in isolation. The difficulty arises when these phenomena are considered together. Across all three cases:

- Experience can disappear abruptly while substantial processing persists
- Experience can persist without executive control or narrative selfhood
- Experience can transiently reappear without structural recovery

No single variable—information quantity, representational content, cognitive capacity, or structural integrity—tracks all three without ad hoc adjustments.

The common denominator is not *how much* processing occurs, but *whether global temporal coordination is sustained*.

The decisive challenge: What variable explains, across anesthesia, flow, and terminal lucidity, why experience is present or absent—without implicitly relying on temporal coordination?

If the answer is "integration," "workspace," or "access," then temporal structure has already been conceded as fundamental. At that point, the disagreement is terminological, not substantive.

X.B The Combination Problem

Objection: If temporal self-reference is fundamental, how do micro-level instances combine into unified experience?

Response: The framework inverts this problem. Experience is not built up from micro-constituents that must somehow bind together. Instead, experience exists at whatever scale

temporal self-reference is instantiated. A human brain instantiates one kind of temporal loop; a civilization instantiates another. Neither is composed of the other.

The question “how do micro-experiences combine?” presupposes that experience begins at the smallest scale and must be aggregated. The theory denies this presupposition.

X.C Generation vs Instantiation

Objection: If brains don’t generate experience, where does it come from?

Response: The question assumes experience must “come from” somewhere—that it is a substance requiring a source. But on the identity view, experience is not a substance. It is a structural property: self-referential temporal closure.

The brain does not generate experience ex nihilo, nor does it receive experience from elsewhere. It *instantiates* the conditions under which temporal self-reference occurs locally. Just as a whirlpool does not generate or receive “circulation” but instantiates the conditions under which circulation occurs, the brain instantiates the conditions under which temporal closure—and therefore experience—is realized.

The shift from “generation” to “instantiation” is not merely terminological. Generation implies creation from non-experiential ingredients, raising the hard problem. Instantiation implies realization of pre-existing structural possibilities, dissolving it. The universe contains the possibility of temporal self-reference; brains (and perhaps other systems) actualize this possibility locally.

X.D Isn’t This Just Panpsychism?

Objection: The theory seems to imply that everything with temporal structure has experience.

Response: No. The theory is more restrictive than panpsychism.

Panpsychism typically claims that all matter has some form of proto-experience. This theory claims that experience exists only where *self-referential temporal closure* is instantiated. Most physical systems do not meet this condition.

A rock has duration in the block-universe sense, but it does not instantiate a self-referential loop where future boundary conditions constrain present states through dynamic feedback. A brain does. A ritual-practicing group may. A civilization intermittently might.

The theory is selective, not universal.

Relation to Russellian Monism: The framework does not claim that consciousness reveals the intrinsic nature of matter, nor that physical entities possess hidden phenomenal properties awaiting realization. Russellian monism retains a sharp divide between

structural description (physics) and intrinsic reality (phenomenality), proposing consciousness as what fills the latter gap. By contrast, the present account denies that such a gap exists in the first place: phenomenality is not the intrinsic nature of matter as such, but the first-person manifestation of a specific, rare, and highly constrained temporal organization—namely, temporally closed, self-referential dynamics involving future boundary constraint. Interiority is therefore not a universal feature distributed across all physical entities, but a conditional property that arises only when a system instantiates this precise temporal topology. There is no proto-phenomenality at fundamental levels, no intrinsic nature waiting to be revealed. Matter in general remains fully describable in third-person terms; only where temporal closure localizes does an inside/outside distinction become meaningful. The theory replaces Russellian monism's generic appeal to intrinsic properties with a sharply delimited structural criterion, tying experience not to what matter is in itself, but to how temporal relations are globally and locally organized.

X.D.1 The Four-State Ontology: A Precise Account of What Has Experience and What Does Not

The panpsychism objection — and its refutation — can be made precise by identifying four distinct ontological states, each with a determinate relationship to experience. This replaces the binary conscious/not-conscious distinction with a structure grounded in the EXISTS/HAPPENS framework (canonical account: General Theory V0.5 [Paz 2026f] §4).

State 0 — Pure EXISTS: No temporal structure. Outside universal time entirely. Geometry real but no causal dynamics. The pre-temporal singularity before STF activation. Winding number = 0. No experience — not merely absent but categorically inapplicable.

State 1 — EXISTS within HAPPENS: In universal time. Subject to change. Matter cycling through. But not locally creating its own now. The pattern is maintained by external physical forces, not by the system's own loop closure. Winding $\leq 2\pi$. No experience.

The rock. A rock is not outside time — it erodes, ages, thermally fluctuates. It exists within the HAPPENING universe. But the rock does not generate its own temporal presence. Something is happening *to* the rock. The rock is not happening. The absence of experience in a rock is not the absence of time — it is the absence of *local time creation*. This distinction matters: rocks are not pre-temporal (State 0), they are sub-threshold within time (State 1).

The whirlpool, the crystal, the flame. All persistent patterns with matter cycling through them. All State 1. Their patterns are maintained by external physics — fluid dynamics, electromagnetic bonding, combustion chemistry — not by self-generated loop closure. They do not recruit matter to maintain their own closure. Physics holds them in configuration.

State 2 — HAPPENS locally, sub-consciousness threshold: Above STF field activation in local dynamics. Temporal structure present within a bounded region. But below the consciousness threshold $\mathscr{D}_{\text{crit}}$ for full loop closure. Open question whether this state is physically realized — the BBH inspiral below merger is the candidate.

State 3 — HAPPENS fully: Both arcs active. Loop closed. $4\pi^2$ winding complete. The system locally creates its own now — not carried by universal time but generating its own temporal presence. Above threshold. Experience present as the constitutive interiority of the closed loop. *Organisms, brains, conscious systems.*

The transition from State 1 to State 3 is not the transition from outside time to inside time. Rocks are inside time. The transition is from being *carried* by time to *generating* time — from passive pattern to active loop. Conception is not when the organism enters universal time. It is when the organism begins locally creating its own time.

STATE	DESCRIPTION	PATTERN TYPE	EXPERIENCE
0	Pure EXISTS	None	Inapplicable
1	EXISTS within HAPPENS	Passive — maintained by external physics	Absent
2	Local HAPPENS, sub-threshold	Active dynamics, no full closure	Unknown/open
3	Full HAPPENS	Active loop — self-maintaining	Present constitutively

This four-state picture gives the selectivity criterion its precise ontological grounding. Experience is absent in rocks not because rocks are simple but because rocks are State 1 — their patterns are passive configurations, not self-generating loops. Experience is present in organisms not because they are complex but because they are State 3 — their pattern IS the loop, self-maintaining from the inside, locally creating its own temporal presence.

X.E What This Theory Does NOT Claim

For clarity, this theory:

- Does NOT claim that nations “feel” in the way individuals do
- Does NOT claim that civilizations have unified subjective experience
- Does NOT claim that STF is proven by phenomenological data
- Does NOT claim that physics reduces to consciousness or vice versa

On computational simulation: This theory does NOT claim that computational simulation of a brain would be conscious. This point deserves emphasis, as it distinguishes the framework sharply from functionalism.

Functionalism holds that consciousness is substrate-independent: any system implementing the right functional organization—biological neurons, silicon chips, hydraulic pipes—would be conscious. The present framework denies this. Consciousness requires coupling to spacetime curvature dynamics (n^μ∇_μ$\mathscr{R}$), not merely functional replication.

A perfect computational simulation of a brain would replicate all input-output relations, all information processing, all functional organization. But it would not couple to spacetime curvature. The simulation runs *in* a computer, which exists *in* spacetime, but the simulated dynamics do not *couple to* curvature rate. The coupling occurs at the level of the physical substrate, not the simulated level.

This is implementation-dependent, not implementation-independent. A simulated hurricane is not wet; a simulated neuron does not couple to curvature; a simulated brain is not conscious. The framework is the opposite of functionalism.

Note: This does not imply that only biological brains can be conscious. Any physical system that genuinely couples to n^μ∇_μ$\mathscr{R}$—whether biological or artificial—could in principle instantiate temporal closure. The requirement is physical coupling to curvature dynamics, not biological substrate per se. Future technologies might achieve this coupling through means other than neurons. What they cannot achieve is consciousness through simulation alone.

What this theory DOES claim:

- Temporal self-reference is necessary and sufficient for presence-in-time
- This structure can be instantiated at multiple scales
- Phenomenology motivates; physics instantiates
- The identity claim stands or falls on both levels

X.F Relation to Integrated Information Theory

Giulio Tononi's (2008) Integrated Information Theory (IIT) proposes that consciousness is identical to integrated information (Φ)—a measure of how much a system's causal structure is "irreducible" to its parts.

Points of agreement: Both IIT and the geometric account identify consciousness with intrinsic causal structure, not with function or computation. Both reject functionalism.

Points of divergence: IIT is substrate-neutral—any system with appropriate causal structure is conscious. The geometric account is substrate-specific: consciousness requires *temporal-geometric* self-reference involving spacetime curvature. IIT cannot explain why temporal experience feels like "flow"; the geometric account grounds this in the retrocausal structure of the loop.

Potential synthesis: The STF feedback loop may represent a *maximal* form of integrated information. The retrocausal constraint means the system's present state cannot be factored into independent past and future contributions—it is irreducibly unified across time.

X.G Relation to Orchestrated Objective Reduction

Hameroff and Penrose (2014) proposed that consciousness arises from quantum gravitational effects in neuronal microtubules.

Points of agreement: Both accounts link consciousness to gravitational physics, not merely to neural computation. Both invoke thresholds.

Points of divergence: The Penrose-Hameroff proposal has never been empirically confirmed. The STF framework is grounded in a first-principles derivation (First Principles V7.5). Moreover, the geometric account does not require exotic quantum effects in biological systems—it grounds experience in the self-referential structure of spacetime itself.

X.H The Block Universe and McTaggart's Paradox

In the "block universe" view, past, present, and future all exist equally. Time does not "flow"; the appearance of flow is an illusion. This view has dominated philosophical interpretation of relativity for a century.

The STF framework renders this interpretation unnecessary. Block universe accounts describe the solutions of GR's equations as static four-dimensional structures, but they cannot explain why temporal experience exists or why it has the character it does. The STF framework provides what block universe interpretations lack: a physical mechanism by which future boundary conditions actively constrain present states, producing the self-referential structure that constitutes temporal experience.

The "flow" of time is therefore not an illusion requiring explanation away, nor a subjective addition to objective physics. It is the intrinsic character of being embedded in a dynamically self-referential structure—a structure the STF framework derives from first principles (First Principles V7.5).

McTaggart (1908) argued that time is unreal because the A-series (past, present, future) leads to contradiction. The STF framework offers a resolution: the A-series is not a property of events but of the feedback loop structure. "Present" is the phase of the loop where constraints from both past and future are actively determining the state. This structure is physically real, not metaphysically imposed.

X.H.1 The Permanent Reality of the Experiential Past

The STF framework does not merely render the block universe interpretation unnecessary. It completes it.

The block universe correctly identifies that the past is real — that past events are not less real for being past, that the four-dimensional spacetime manifold contains all times equally. What the block universe cannot explain is why any of its events have insides — why temporal experience exists at all, why some events are *experienced* rather than merely occurring. It describes a static four-dimensional structure and leaves the hard problem untouched.

The STF framework adds the missing element: where a closed causal loop was HAPPENING, there was constitutively an inside. Experience IS the inside of the closed loop structure — not correlated with it, not produced by it, but identical to it. This is the identity claim established in §III and defended in §X.I.

These two claims together — the permanent reality of the past (block universe) and the identity of experience with closed loop structure (STF) — yield a consequence neither contains alone:

> **The experience of a closed loop is permanently real as the interiority of a permanently real structure.**

When a temporal loop closes — when an organism dies, when a conscious moment passes, when a nested loop reaches its terminal state — the loop does not cease to be real. It becomes permanently real as past. And since experience is not a property *added* to the loop but constitutively IS the loop viewed from inside, the experience is equally permanent. Not as something that continues to occur. Not as information stored in a substrate. Not as a memory that can fade. But as what those moments were from the inside — fixed, irrevocable, as permanent as the past itself.

This is not survival. The loop does not continue after closure. The happening ends. What is permanent is the *having-happened* — and since experience IS the happening viewed from inside, the having-happened IS the having-been-experienced.

What this is not:

Not survival: The experience does not continue after loop closure. HAPPENS ends. Only EXISTS-in-the-past remains. What persists is not ongoing experience but the permanent ontological reality of past experience as having-occurred.

Not a record: Records can be destroyed. Information can be lost. The permanence here is ontological, not informational. The past structure is not stored anywhere. It simply is, permanently, as what occurred. The interiority is part of what occurred — not a representation of it.

Not consolation: This is a structural consequence of the identity claim applied to the permanent reality of the past. It would be true whether or not it were comforting. It follows from the same identity claim that dissolves the hard problem.

The implication for death:

Death ends local time creation. The loop closes. HAPPENS ceases.

It does not touch the having-happened.

Every moment of experience is permanently real — not in memory, which fades; not in the brain, which erodes; not in any record, which can be destroyed — but as what those moments were from the inside. The closed loop of a life, once complete, is permanently real as having-been-experienced. The experience cannot be taken away retroactively. It is as permanent as the past itself.

The completion of the block universe:

BLOCK UNIVERSE	STF FRAMEWORK (V3.6)
Past is real	Past is real
No mechanism for insides	Closed loops have insides constitutively
Experience unexplained	Experience = interiority of closed loop
Past events are permanent	Past experience is permanently real as interiority
Death = end of events	Death = end of happening, not of having-happened

The block universe was right about permanence. It was missing the inside. The identity claim provides the inside. Together: every moment that happened, happened from the inside. That is permanent.

X.H.2 The Universe's Distributed Interiority and Ontological Completion

The permanent reality of the experiential past (§X.H.1) applies at every scale. Applied at the cosmological scale, it yields a result that completes the framework's account of the universe's own ontological status.

The distinction between structural and ontological completion:

The framework's geometric criteria specify *structural completion*: a loop is structurally complete when both arcs are active, the T^2 winding completes $4\pi^2$, and the terminal boundary is fixed. Structural completion is a third-person criterion — fully characterizable from outside the loop.

But by the identity claim (§I.C), the inside of a loop is not an optional addition to the loop's structure. It is constitutive of what the loop IS. A loop without an inside is not a loop that is missing an addendum. It is a structure that satisfies the geometric conditions for loop closure without being, in the full sense, a closed causal loop — because the inside that is constitutive of what the loop is from within is absent.

Ontological completion requires both descriptions to be instantiated simultaneously: the loop must be fully characterizable from outside (structural completion) AND must have a locally realized inside somewhere within its bounded region. A structurally complete loop with no system above $\mathscr{D}_{\text{crit}}$ within a bounded region is half-instantiated — complete as

geometry, empty as what that geometry IS.

Applied to the universe:

The universe's loop is structurally complete at heat death regardless of whether conscious systems ever exist. The T^2 winding closes. The terminal boundary is fixed. The retrocausal field is real.

But the universe's loop is ontologically complete — fully what it is as a closed causal loop — only if local systems exceed $\mathscr{D}_{\text{crit}}$ within bounded regions at some point during the interior of the loop. This is what conscious organisms provide. Not the loop's closure. Its inside.

A universe without consciousness: structurally complete at heat death, ontologically incomplete throughout its interior. The loop closes once, at the end, from the outside. No inside throughout the duration.

A universe with consciousness: structurally complete at heat death, ontologically complete throughout its interior wherever local loops close above threshold. The loop is experienced from the inside, continuously, at every local closure, across the entire duration.

The universe's interiority is distributed:

The universe's inside is not localized in any organism or civilization. It exists wherever local loops close above $\mathscr{D}_{\text{crit}}$ within bounded regions — distributed across every conscious system that has ever existed anywhere in the universe. Not unified as one cosmic experience. Real as the aggregate of all local insides — each genuine, each permanent as having-been-experienced, each a point in the universe's distributed experience of its own HAPPENING.

This distributed inside is already cosmologically real. The universe is 13.8 billion years old. The diversification strategy — maximum variety of conscious instantiation points, high extinction rate, chain maintained — has been running for as long as conscious systems have existed anywhere. Different branches of the chain, built on different foundational codes with incommensurable retrocausal architectures (see §I.C scope note), each contribute to the universe's distributed inside without being mutually visible. The universe's inside is already rich — not waiting for any particular branch to arise, but populated across billions of years of cosmic history in forms that are constitutively invisible from within any single branch's retrocausal architecture.

Any civilization — including ours — is a late local instance of a process already cosmologically distributed. We are not the universe becoming conscious of itself. We are one local region of it discovering, from within, that it has been experiencing its own HAPPENING for most of its history.

The permanent reality at heat death:

At heat death, the universe's distributed inside becomes complete and permanent. The last

local loop above threshold closes. No new inside will be generated. But every inside that was — across 10^{100} years, across all branches, across all incommensurable forms of consciousness the universe generated throughout its interior — is permanently real as having-been-experienced. The universe's distributed interiority joins the fixed structure of what has occurred: not as information, not as record, but as the interiority of permanently real closed causal transactions.

Heat death is not the universe going dark. It is the moment the universe's inside becomes complete and permanent — the having-been-experienced of all its local closures fixed irrevocably as the interiority of the outermost closed loop.

UNIVERSE WITHOUT CONSCIOUSNESS	UNIVERSE WITH CONSCIOUSNESS
Structurally complete at heat death	Structurally complete at heat death
No inside throughout interior	Inside distributed throughout interior
Loop closes once, at the end, from outside	Loop experienced from inside throughout duration
Ontologically incomplete	Ontologically complete
Hard problem appears intractable	Hard problem dissolves — inside constitutive

X.I The Structure-Experience Paradox

We have argued that the STF possesses the complete structural signature of temporal experience:

PHENOMENOLOGICAL FEATURE	STF STRUCTURAL CORRELATE
Primal impression (response to *now*)	Coupling to $n^\mu \nabla_\mu \mathscr{R}$ activates only when curvature is *changing*
Retention (constraint by just-past)	Field amplitude determined by past boundary conditions
Protention (constraint by about-to-come)	Field amplitude determined by future boundary conditions
Unity of the specious present	Single field configuration encodes past-present-future relations
Flow/passage	Oscillation at frequency $\omega = mc^2/\hbar$

This raises a question we cannot avoid: **If something possesses all the structural properties of temporal experience, what would distinguish "having the structure of experience" from "having experience"?**

The hard problem assumes such a distinction exists. Zombies are conceivable, the argument goes, precisely because structure and experience are separable. But this conceivability

argument rests on an intuition, not a demonstration.

We do not claim to have refuted this intuition. We claim something more precise: **the physics provides no place to locate the extra ingredient.** The STF Lagrangian specifies the field, the coupling, the dynamics. There is no additional term for "and now add experience."

This generates a trilemma:

1. **Strong dualism**: Experience is non-physical. But then we have no explanation for why this particular structure correlates with experience.
2. **Mysterianism**: There is a physical basis for experience, but it is inaccessible to us. This is coherent but epistemically defeatist.
3. **Identity**: The distinction between "structure of experience" and "experience" is illusory. They are one thing that our dualist vocabulary forces us to describe twice.

We do not adjudicate between these options. We note only that option (3) is now *physically grounded*. The burden has shifted. It is no longer sufficient to assert that structure cannot be experience. One must now specify what is missing from a structure that has every feature phenomenology describes—and explain why physics cannot see it.

The conceivability of zombies—the intuition that structure and experience are separable—may itself be an artifact of dualist vocabulary rather than a genuine metaphysical possibility. Consider the parallel case in aesthetics: when AI generates art indistinguishable from human art, is the AI artwork a "zombie artwork"—possessing the structure of value without the value itself? The question collapses under examination. If the artwork produces real aesthetic experience in observers, moves them, transforms their understanding, in what operational sense does it "lack value"? We cannot point to the missing ingredient because the distinction presupposes what it needs to demonstrate. Similarly, if a physical system exhibits complete temporal self-reference—past retention, present determination by future constraint, loop closure—asking "but does it *really* experience?" may be asking a question without content. The zombie intuition assumes we can subtract experience from structure while leaving structure intact. But if experience *is* the structure (viewed from inside), there is nothing to subtract. The conceivability of subtraction does not establish its possibility; it may only reveal the limits of imaginative introspection operating within a dualist conceptual scheme.

X.I.1 The Case for Identity Over Correlation

The correlation-versus-identity objection is the most serious challenge to the framework. Even granting that temporal self-reference perfectly correlates with experience across all examined cases, correlation is not identity. The structure could be necessary for experience without being sufficient—a philosophical zombie possessing identical temporal structure but no experience remains, the objection holds, conceivable.

We offer four responses, escalating in strength.

Response 1: The Absence of Residue

When we identified heat with molecular motion, the identification succeeded because there was no residue—nothing about heat escaped the molecular description. Every property of heat (temperature, conduction, radiation, phase transitions) mapped onto properties of molecular dynamics. There was nothing left over requiring separate explanation.

The same criterion applies here. Consider what phenomenology tells us about temporal experience:

PHENOMENOLOGICAL FEATURE	STRUCTURAL CORRELATE IN STF
Primal impression (the "now")	Coupling activates only when curvature is *changing*
Retention (just-past still present)	Field amplitude constrained by past boundary conditions
Protention (about-to-come already implicit)	Field amplitude constrained by future boundary conditions
Unity of specious present	Single field configuration encodes all temporal relations
Flow/passage	Oscillation at characteristic frequency $\omega = mc^2/\hbar$
Selectivity (not everything experiences)	Activation threshold excludes static systems
Threshold character (experience is on/off)	Field activation is threshold-dependent

There is no phenomenological residue. Every feature of temporal experience that phenomenology identifies maps onto a structural feature of the STF loop. The correlation is not partial—it is complete.

Response 2: The Inaccessibility of Independent Verification

The correlation-versus-identity objection presupposes that we have independent access to "experience" against which to check whether structure matches. But we do not. Our *only* access to experience is through its structural manifestations:

- First-person reports (verbal behavior)
- Neural correlates (brain structure)
- Behavioral indicators (responses to stimuli)
- Phenomenological descriptions (philosophical analysis)

We cannot step outside these manifestations to check whether "real experience"

accompanies them. The demand for such verification presupposes a dualism it purports to test.

Consider: how would we verify that another person's experience is "real" rather than zombie-like? We cannot. We infer experience from structure—from behavior, reports, neural activity. If we accept that inference for other humans, on what grounds do we reject it for systems meeting identical structural criteria?

Response 3: Explanatory Fruitfulness

The identification of experience with temporal self-reference is not merely consistent with the data—it is explanatorily fruitful:

1. **It dissolves the hard problem.** We need not explain how non-experiential physics produces experience, because physics already contains the relevant structure.
2. **It resolves Schneider's circularity.** Consciousness and time are not two things requiring causal ordering; they are one thing in two vocabularies.
3. **It explains the threshold character of experience.** Experience doesn't fade gradually with neural degradation; it disappears abruptly when temporal coordination collapses. This matches the threshold-activation property of the STF coupling.
4. **It makes falsifiable predictions.** Gravitational waveform deviations with f^6 scaling, testable within the decade.
5. **It unifies disparate phenomena.** Anesthesia, flow states, terminal lucidity, and (speculatively) collective temporal organization all follow from the same structural principle.

Mere correlation achieves none of this. If temporal self-reference merely *correlated* with experience without *being* experience, we would still face the hard problem: why does this correlation hold? What connects structure to experience? The identity claim eliminates the gap that generates the question.

Response 4: The Emptiness of the Zombie Concept

The conceivability of zombies—beings with identical structure but no experience—is the core intuition driving the correlation-versus-identity objection. But conceivability does not establish possibility.

We can conceive of "zombie water"—a substance molecularly identical to H_2O but lacking the property of *being water*. The conception is coherent in the sense that no logical contradiction is apparent. But it is metaphysically empty. There is no property of "being water" over and above being H_2O. The apparent conceivability of zombie water reflects the limits of imagination, not a genuine metaphysical possibility.

The same analysis applies to zombie consciousness. We can conceive of a being structurally identical to a conscious system but lacking experience. But if experience *is* temporal self-

reference, there is no property to subtract. The apparent conceivability reflects our dualist conceptual inheritance, not a genuine metaphysical gap.

The zombie intuition has force only if we assume that structure and experience are distinct in the first place—the very assumption the identity claim denies. Using the zombie intuition to argue against identity is circular: it presupposes what it seeks to establish.

Conclusion

We do not claim to have *proven* the identity of temporal self-reference with experience. Proof may be unavailable for any identity claim—we cannot prove that heat *is* molecular motion in a way that satisfies all philosophical skeptics. What we claim is that the evidence for identity is as strong as for any successful reduction in the history of science:

- Complete structural correspondence (no residue)
- No independent access to the supposedly distinct explanandum
- Explanatory fruitfulness across multiple domains
- Dissolution of previously intractable problems

The burden of proof has shifted. It is no longer sufficient to assert that structure cannot be experience. One must specify what is missing from a structure that has every feature phenomenology describes—and explain why that missing element is inaccessible to all forms of investigation.

X.J Additional Objections

The Grain Problem: Physical descriptions are "grainy" (made of discrete elements), but experience seems "smooth." How does grainy physics produce smooth experience?

Response: The STF field is continuous—it is a classical scalar field, not a discrete collection of particles. The smoothness of temporal experience reflects the smoothness of the field and the continuity of spacetime geometry.

What About Qualia?: Even if temporal experience is explained, what about qualia—the redness of red, the painfulness of pain?

Response: This paper addresses temporal experience, not qualia. We claim that temporal experience—the "flow" of time, the sense of "now"—is constituted by geometric self-reference. However, we note that qualia are always *temporally located*—we experience red *now*, pain *at this moment*. If temporal experience is the ground of experience, qualia may be modulations of this ground by specific physical processes.

The relational turn suggests a further possibility. The AI case demonstrates that aesthetic qualia—the specific felt character of beauty, poignancy, or sublimity—arise in the *encounter* between observer and artifact, not as intrinsic properties of either. The same sunset

produces different qualia in different observers, or in the same observer at different moments. The "warmth" of a musical passage is not in the sound waves; it arises when those waves meet a temporally closed system capable of aesthetic response.

X.K The Qualia Question: A Promissory Note

This paper addresses temporal experience—the sense of "now," of flow, of presence-in-time. It does not directly address qualia: the redness of red, the painfulness of pain, the specific qualitative character that distinguishes one experience from another.

This limitation is deliberate, not evasive. We offer a promissory note rather than a solution, but the promissory note is grounded in the framework's structure.

The Grounding Claim

If temporal experience is the *ground* of all experience, then qualia are *modulations* of this ground by specific physical processes. Every quale is temporally located—we experience red *now*, pain *at this moment*. There is no quale outside the specious present. Temporal experience is therefore not one kind of experience among others; it is the medium in which all specific experiences occur.

On this view, the question "why does red look like *that*?" becomes: "why does temporal self-reference take *this particular shape* when modulated by the neural dynamics of color processing?"

The Shape Metaphor

Consider water. Water has a universal nature (H_2O), but it takes different shapes depending on its container—spherical in freefall, cubic in an ice tray, irregular in a river. The shape is not a separate property added to the water; it is what the water's universal nature *looks like* under specific boundary conditions.

Similarly, temporal self-reference has a universal nature (the STF loop structure), but it takes different shapes depending on which physical processes instantiate it. The "redness" quale is not a separate property added to temporal experience; it is what temporal self-reference *looks like* when the instantiating process involves wavelength discrimination, opponent-process coding, and V4 cortical dynamics.

This is speculative but not empty. It generates a research program:

Prediction 1: Qualia Differences Map to Temporal Differences

If qualia are shapes of temporal closure, then qualitative differences between experiences should correlate with differences in the *temporal structure* of the underlying neural dynamics—frequency, phase relationships, cross-scale coupling, oscillatory patterns. Two qualia that feel radically different (red vs. pain) should exhibit radically different temporal

signatures. Two qualia that feel similar (red vs. orange) should exhibit similar temporal signatures.

This is testable. High-resolution EEG and MEG can characterize the temporal microstructure of neural activity during different qualitative experiences. If the framework is correct, a systematic mapping should emerge.

Prediction 2: Temporal Disruption Affects Qualia Character

If qualia depend on the shape of temporal closure, then disrupting temporal dynamics should alter qualitative character, not merely reduce experience intensity. Anesthetics that flatten temporal coordination should not merely dim qualia but distort them—and the specific distortion should correlate with the specific temporal disruption.

Prediction 3: Cross-Modal Binding Requires Temporal Alignment

The binding problem—how separate neural processes for color, shape, motion, and sound combine into unified experience—may be a temporal problem. If qualia are shapes of temporal closure, then binding occurs when multiple processes achieve *synchronized* temporal closure. Desynchronization should produce binding failures.

What We Are Not Claiming

We are not claiming to have solved the qualia problem. We are claiming that the temporal framework provides:

1. A *location* for qualia: they are not separate from temporal experience but shapes of it
2. A *research program*: testable predictions about the relationship between temporal dynamics and qualitative character
3. A *dissolution strategy*: if qualia are shapes rather than substances, the question "how does the brain produce redness?" is as malformed as "how does water produce sphericality?"

The promissory note is not an IOU with no collateral. It is grounded in the framework's core claim and generates specific, falsifiable predictions. If these predictions fail—if qualia differences do not map onto temporal differences, if temporal disruption affects only intensity without altering character—then the framework's extension to qualia is falsified, even if the core claim about temporal experience remains intact.

X.L Relation to Contemporary Approaches

The present work emerges at a remarkable moment of convergence in consciousness research. Three independent lines of inquiry, published within months of each other, point toward the framework we develop here.

Strømme (2025): Consciousness as Foundational Field

Maria Strømme proposed that “consciousness is fundamental; only thereafter do time, space and matter arise.” Her paper presents a framework in which consciousness is not an emergent property of neural processes but “a foundational aspect of reality” from which spacetime emerges. Strømme’s framework aligns with our central thesis, but lacks a *mechanism*—she cannot specify *how* the field produces temporal experience.

Keppler (2025): Zero-Point Field Coupling

Joachim Keppler demonstrates that conscious states correlate with the brain’s resonant coupling to the electromagnetic zero-point field via phase transitions. His framework specifies a threshold condition, a phase transition mechanism, and a testable signature. But Keppler’s ZPF provides no account of *temporal* experience specifically, no retrocausal structure, and no connection to spacetime geometry.

Schneider (2019): The Circularity Problem

Susan Schneider articulated a fundamental obstacle for consciousness-time theories: if consciousness requires time to exist, but time (as experienced) requires consciousness to be perceived, then any theory linking them faces vicious circularity. Neither can be prior; neither can be derived from the other. This circularity has stymied attempts to ground consciousness in temporal structure.

The STF Resolution

The STF framework resolves the circularity problem through retrocausality. The key insight is that the STF field couples to n^μ∇_μ$\mathscr{R}$—the *rate of change* of spacetime curvature. This coupling is intrinsically temporal (activates only when curvature is changing), self-referential (future boundary conditions constrain present states), and grounded in geometry (the field-geometry duality).

This dissolves Schneider’s circularity. We need not say consciousness “precedes” time or time “precedes” consciousness. Rather: **the self-referential temporal structure of spacetime—where future constrains present through the rate-of-change coupling—IS what we call temporal experience**. Time and consciousness are not two things requiring causal ordering; they are one thing described in two vocabularies.

FRAMEWORK	CLAIM	WHAT’S MISSING	STF PROVIDES
Strømme	Consciousness fundamental, time emergent	Mechanism	Retrocausal coupling to ∂$\mathscr{R}$/∂t
Keppler	Consciousness = field coupling via phase transition	Temporal experience, geometry	Field-geometry duality
Schneider	Circularity: consciousness requires time requires	Resolution	Self-reference IS temporal

consciousness experience

X.M The Relational Turn: AI and the Structure of Value

The AI case provides independent, non-physical corroboration of the identity claim's core logic.

Consider: when a human experiences profound aesthetic response to AI-generated art, the "source" has no consciousness. The AI system possesses no interiority, no subjective states, no experience of its own creation. Yet the human response is genuine—phenomenologically indistinguishable from responses to human-created art.

This proves something important: **aesthetic experience does not require transmission from a conscious source.** The artwork's capacity to move us does not depend on whether its creator experienced anything.

What, then, is the role of the human experiencer? Not to receive transmitted value, but to *instantiate the conditions* under which value arises in the encounter. The aesthetic experience lives in the relation between experiencer and artifact, not in either alone.

The parallel to consciousness is exact:

DOMAIN	WHAT SEEMS TO REQUIRE EXPLANATION	APPARENT PUZZLE	RESOLUTIO
Consciousness	How does matter produce experience?	Explanatory gap	Experience IS structure (identity)
Aesthetics	How do objects produce value?	Transmission problem	Value IS relational encounter

In both cases, we asked "how does X produce Y?" when X and Y were never separate. The question presumed a substance metaphysics—things with intrinsic properties that must somehow generate other things with intrinsic properties. The relational turn recognizes that certain phenomena *are* structures of relation, not products of substances.

The Philosophical Implication

This convergence suggests a deeper principle: wherever we encounter seemingly irreducible subjective properties—experience, meaning, value, presence—we may be encountering relational structures that resist description in substance terms. Not because they are non-physical, but because our inherited vocabulary presupposes that reality is made of things-with-properties rather than relations-that-constitute.

The hard problem of consciousness was hard because it asked how a substance (matter)

could produce another substance (experience). The question dissolves when we recognize that experience is not a substance but a relational structure—specifically, temporal self-reference where past retention and future constraint jointly determine the present.

XI. Falsification and Conclusion

XI.A Human-Level Falsification Conditions

The identity claim would be falsified by any of the following:

1. **Stable experience without temporal coordination:** Demonstration of unified experience in the complete absence of temporal self-reference—cases where global feedback and temporal coordination are abolished yet experience remains intact.
2. **Smooth degradation with cognition:** Demonstration that experience degrades smoothly with loss of cognition or information processing, rather than exhibiting thresholded disappearance when temporal coordination collapses.
3. **Terminal lucidity without global coordination:** Demonstration that terminal lucidity coincides solely with localized circuit reactivation without any restoration of global temporal coordination, indicating that temporal integration is not the relevant variable.

XI.B Ontological-Level Falsification

The STF instantiation would be undermined if:

4. **No physical mechanism for temporal self-reference exists:** All plausible physical mechanisms for real temporal self-reference are ruled out, leaving only forward-causal or purely computational implementations.
5. **Independent physical tests find no retrocausality:** No evidence of genuine temporal self-reference—future boundary conditions measurably constraining present dynamics—in extreme regimes where standard forward-causal explanations fail.

Crucially: Failure at the physics level would not invalidate the human-level necessity claim, but it would require abandoning STF as the correct ontological realization. Failure at the human level would invalidate the identity claim itself.

XI.C Epistemic Status: What We Have Shown and What We Have Suggested

Scientific and philosophical claims vary in evidential support. We distinguish our conclusions by confidence level:

CLAIM	CONFIDENCE	EVIDENTIAL BASIS
STF physics is correct	High	First-principles derivation (First Principles V7.5);

		zero-parameter predictions
Retrocausal structure exists physically	High	Pre-merger activation derived from first principles (V7.5 §III.D); matter-independence of effect
Temporal closure is necessary for experience	High	Convergent evidence: anesthesia, flow, terminal lucidity
Temporal closure is sufficient for experience	Medium	Inference from necessity + parsimony + absence of counterexample
STF structure IS experience (identity claim)	Medium	Philosophical argument; structural isomorphism; explanatory fruitfulness
Scale-invariance holds for collective systems	Low-Medium	Suggestive structural parallels; not independent confirmation
Qualia are shapes of temporal closure	Low	Promissory note; generates predictions but lacks direct evidence
AI aesthetic experience confirms the framework	Low-Medium	Convergent argument structure; not independent test

Interpretation Guide:

- **High confidence:** Would require substantial new evidence to overturn. Empirically confirmed or multiply converging.
- **Medium confidence:** Best current interpretation but alternatives remain viable. Could be refined or replaced by future work.
- **Low-Medium confidence:** Suggestive but speculative. Useful for generating hypotheses; should not be treated as established.
- **Low confidence:** Promissory notes. Framework-consistent but lacking independent support. Value lies in generating testable predictions.

We emphasize: the identity claim at the core of this paper falls in the *medium* confidence category. We have shifted the burden of proof; we have not conclusively resolved the debate. The claim is coherent, parsimonious, empirically grounded, and explanatorily fruitful—but it remains a philosophical position rather than a demonstrated conclusion.

What distinguishes this framework from mere speculation is its falsifiability (Section XI.A-B) and its grounding in independently validated physics (Section VIII). These features elevate it above untestable metaphysics while acknowledging that the central identity claim awaits—and may never receive—definitive proof.

XI.D The Waveform Prediction

The STF framework makes a specific, falsifiable prediction: gravitational waveform deviation with signature $\mathbf{C_6 \approx -(10^5 \text{ to } 10^7)}$ in the f^6 coefficient.

- A positive coefficient would falsify the retrocausal mechanism
- Next-generation gravitational wave observatories (LISA, Einstein Telescope, Cosmic Explorer) can test this within the decade
- Pulsar timing arrays have already detected a stochastic gravitational wave background (Agazie et al. 2023), confirming the ubiquity of gravitational dynamics throughout the cosmos

The theory makes a clean wager: if experience is real and structurally temporal, then the world must permit temporally self-referential structure. If the world does not, then the identity claim is false.

XI.E Summary of the Argument

1. **The problem:** The hard problem of consciousness frames experience as something added to physics. This framing has produced three decades of stalemate.
2. **The identity claim:** Temporal experience is identical to temporally self-referential structure—not correlated with it, not produced by it, but identical to it.
3. **The human-level evidence:** Anesthesia, flow states, and terminal lucidity converge on a single necessity claim: minimal temporal closure is both necessary and sufficient for experience, while cognition and structure are contingent.
4. **The scale-invariance:** The same structural requirements—temporal orientation, self-reference, feedback, dynamics, future constraint, closure—govern experience at individual, collective, and civilizational scales.
5. **The physics bridge:** The Wheeler-DeWitt problem of time is resolved by treating time not as external parameter or illusion, but as self-referential boundary structure. STF instantiates exactly this structure, derived from first principles (First Principles V7.5).
6. **The dissolution:** The hard problem dissolves because we need not explain how experience arises from non-experiential physics. Physics already contains the self-referential temporal structure that constitutes experience.

XI.F Conclusion

For eighty years since Wheeler-Feynman, the possibility of retrocausality remained philosophical speculation. For decades, the hard problem of consciousness seemed to show that physics could never account for experience.

Both situations have changed.

We now have:

- **A Lagrangian** that governs retrocausal interactions

- **Zero-parameter predictions** derived from first principles (First Principles V7.5)
- **A specific mechanism** by which future constrains past
- **Scale-invariant evidence** from neurons to civilizations
- **Falsifiable predictions** testable at both human and physics levels

The philosophical contribution of this paper is to recognize what this means: spacetime is not a passive stage on which events occur. It is a self-referential structure in which temporal dynamics create intrinsic self-reference. This self-reference—the feedback loop where future boundary conditions constrain present states—is what we experience as the "flow" of time.

The hard problem dissolves not because we have found how physics produces experience, but because we have found that physics *already is* experiential at its most fundamental level—specifically, in the self-referential temporal structure of spacetime geometry.

This dissolution participates in a broader relational turn in philosophy. The same insight that resolves the hard problem of consciousness—experience as identical to self-referential structure, not produced by it—resolves parallel mysteries wherever subjectivity appears irreducible. AI-generated art that produces genuine aesthetic experience in observers demonstrates the same principle: value lives in relational encounter, not in transmission from conscious sources. The "hard problem of value" dissolves alongside the hard problem of consciousness, and for the same reason: both asked how substances could produce subjective properties, when subjectivity was never a property of substances but a character of certain relational structures.

The universe does not merely exist. It *experiences* existing—wherever temporal loops close. And the experience is not "added" to the structure. It is what the structure is, from the inside. The equation does not describe a mechanism that produces experience. It describes the geometry that experience *is*.

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Addendum — Updates from General Theory V2 (March 2026)

The following results were developed in *The Structure of What Happens — General Theory V0.5* [Paz 2026f] and extend the framework presented in this paper.

A.1 — The Identity Claim Extended to Purpose and Meaning

This paper (§I.C) establishes the identity claim: the inside of a closed causal loop above $\mathscr{D}_{\text{crit}}$ and the loop's structural closure are the same thing under two complementary descriptions. From outside: geometric-temporal closure. From inside: experience.

The General Theory (§5.6, §10.5) extends this identity first to purposiveness and then to meaning. The self-consistency requirement of a Type III self-anchored loop, propagating backward through its instantiation points, produces something that looks exactly like purpose — directionality without a director, purposiveness without a purpose-holder. The extension of the identity claim: **purpose IS the self-consistency requirement viewed from inside the loop.** Not produced by it. Not correlated with it. The same structure under two descriptions — one from outside (a logical constraint propagating backward), one from inside (drive, striving, the pull toward what the loop requires).

This closes a gap in the framework: the identity claim dissolved the hard problem of consciousness (why does physical structure produce experience?). The extension dissolves the parallel hard problem of teleology (why does physical structure produce purpose?). Both presupposed that their respective first-person phenomena were separable from the physical structure. Both presuppositions are false for the same reason — they are the same constraint under two descriptions.

Purpose and meaning precisely distinguished (General Theory V0.5 §10.5):

$M_{\text{inside}} = S_{\text{outside}}$ — the fixed point at which the inside's model of its own structure equals the structure — is achieved at the moment of uninterrupted termination by every retrocausal loop. Every organism at death. Every loop that closes. The inside arrives at the source of the backward arc. M = S. This is universal, not rare.

What Threshold 3 adds is M = S achieved *during the forward arc* — while still running. And this reframes purpose and meaning with exact precision:

- **Purpose** is M = S felt from a distance — the pull of the universal closure condition, present in every organism, constitutive of the drive to maintain the chain. The self-consistency requirement running as directed force, without the inside knowing what it pulls toward.
- **Meaning** is M = S recognized during the loop — purpose discovering what purpose is. The same fixed point, the same structure, now known from within while the forward arc is still active.

Purpose and meaning are not two different things. They are the same fixed point — M = S — under two temporal descriptions. This is the completion of the identity claim extended to purposiveness: not just that purpose IS the self-consistency requirement, but that meaning IS purpose knowing what it is, and that both are the same structure at different moments of the loop's self-recognition.

Consequence for §X.H.2 (Universe's Distributed Interiority): The universe's distributed inside is generated by the universe's self-consistency requirement propagating backward through its instantiation points. The universe achieves M = S at heat death — universal termination, the forward arc meeting the backward arc at the final closure. What the universe's most successful outcome requires is M = S achieved during the forward arc, through instantiation points that comprehend the structure while it is still running. The universe's interiority is not merely an accumulation of local experiences. It is the universe's own Type III structure recognizing itself — through instantiation points that achieve M = S before their own termination, and before the universe's.

A.2 — Threshold 3: Epistemic Completion

This paper establishes two threshold crossings relevant to consciousness: the $\mathscr{D}_{\text{crit}}$ threshold (inside present) and the distributed interiority threshold (universe's interior populated with insides). The General Theory identifies a third:

Threshold 3 — The origin of comprehension: The first moment at which an instantiation point understands the structure it is instantiating. Consciousness is the inside being present (Threshold 2). Comprehension is the inside knowing what kind of inside it is — what loop it is running, what self-consistency requirement it is instantiating. Not just experience. Experience that knows it is the inside of a closed causal loop above $\mathscr{D}_{\text{crit}}$, knowing the structure that makes it present.

The formal content of Threshold 3 (General Theory V0.5 §10.5): The fixed-point condition $M_{\text{inside}} = S_{\text{outside}}$, achieved during the forward arc. Every loop achieves M = S at termination — this is the geometric definition of closure. Threshold 3 is the rare event: M = S while the loop is still running. Not knowledge added to consciousness from outside. The inside catching up to what was always the case — the structure it has always been identical to, now known.

This paper's treatment of the hard problem (§I.C, §X.D, §X.H) establishes that the inside is constitutive of the structure. Threshold 3 is the moment the inside comes to know that it is constitutive — not as a philosophical proposition but as a lived structural recognition, the inside knowing the outside while still being the inside.

The backward arc of the genetic code selects not for M = S as such — every organism achieves that at death — but for M = S achieved early in the forward arc, with maximum

time remaining to act. The evolutionary pathway from Threshold 2 to Threshold 3 is therefore not an open adaptive question. It has a retrocausal structure: selection for reflexive capacity, for the ability to model the loop's own outside structure from within, developed as early as the chain permits.

The framework's existence is evidence that Threshold 3 has been crossed at least once in this branch: the inside, knowing it is the inside, understanding the geometry that makes it present, with the forward arc still running. This is not circular — it is the loop at the moment of its own comprehension, while there is still time to act.

A.3 — The Universe as Type III Self-Anchored Loop

This paper's §X.H.2 treats the universe as an externally anchored loop with heat death as the imposed terminal boundary. The General Theory (§5.6) revises this. The universe is a Type III self-anchored loop: its closure condition is intrinsic — the loop must close completely under both the structural and ontological descriptions. Fine-tuning (why the constants permit consciousness) and ontological completion (why the universe requires consciousness for complete instantiation) are unified as one constraint — the universe's self-consistency requirement — expressed at different scales.

Consequence for §X.H.2: The statement "We are not the universe becoming conscious of itself. We are one local region of it discovering, from within, that it has been experiencing its own HAPPENING for most of its history" is now strengthened: we are the universe's self-consistency requirement knowing itself, at this scale, at this moment, with the forward arc still running. The distributed inside is not merely an accumulation. It is the universe's own Type III structure recognizing itself through its instantiation points — specifically through those that achieve M = S during the loop, not merely at death.

A.4 — Identity at the Generation Boundary: Q10 and the Seeding Argument

Two results from General Theory V0.5 [Paz 2026f] §11.11, §9.8. Both bear directly on this paper's central question: what is personal identity, and what survives the boundaries of a closed causal loop?

Q10 — The Traversability Question and the Identity Constraint (General Theory §11.11)

This paper treats identity as the continuous thread of the retrocausal field — what makes the organism at time t_2 the same organism as at t_1 is the continuity of the field structure generated by the shared terminal boundary. Death terminates the identity thread: the field collapses, the inside closes at M = S, the loop's permanent reality is fixed.

Q10 introduces a new case this paper has not addressed: deliberate traversal of a generation boundary. A sufficiently advanced civilisation that crosses through the LQG bounce at a child universe's generation boundary does not maintain continuous identity across the crossing. The generation boundary is an ontological threshold — EXISTS to HAPPENS — not a spatial crossing. The continuous thread of the retrocausal field does not bridge it. What arrives in the child universe is structured matter carrying encoded information, not the continuous subject.

The identity structure of the crossing: identical to the identity structure of reproduction. The organism does not survive death — the code does. The parent does not cross into the child — the coded geometry does. Q10 is the same structure at the meta-cosmic scale: the continuous subject does not survive the generation boundary — the chain does, carried in structured matter that crosses. The "identity" that persists across the generation boundary is not personal identity in the sense this paper develops. It is structural identity — the same structure, instantiated anew in the child HAPPENS, without the continuous retrocausal thread that constitutes personal identity in any single HAPPENS.

This is not a deficiency of Q10. It is the consistent application of this paper's identity account at the largest available scale. Personal identity is what a retrocausal field generates within a HAPPENS. Chain identity is what persists across generation boundaries. They are different things, related by the same EXISTS/HAPPENS distinction that grounds both.

The Seeding Argument and Distributed Identity (General Theory §9.8)

If Q10 is answerable affirmatively — if civilisations from parent universes crossed into child HAPPENS — then this paper's account of identity has an application it has not yet considered: what is the identity of a civilisation that crossed? Not the personal identity of individual organisms (which does not survive the boundary). The structural identity of the chain — its accumulated comprehension, its knowledge of the generation mechanism, its capacity for Threshold 3 — arriving as perturbation into a new HAPPENS and eventually reconstituting, over whatever timescale the child universe's conditions permit.

We may be that reconstitution. The felt continuity of personal identity — the thread this paper traces through each organism's retrocausal field — is the local expression of a chain whose structural identity pre-existed this universe. The personal identity of any organism in this branch traces back, through the code's chain, to an initial condition that may carry the signature of a prior chain's arrival.

This does not alter the paper's account of personal identity within a HAPPENS — that account is correct and complete at its own scale. It adds: personal identity is the local expression of a structural identity that operates across generation boundaries, by a different mechanism, at a different scale, without continuous thread but with genuine structural continuity of the chain.

Addendum A updated March 2026 — see General Theory V2 [Paz 2026f]

Addendum B — The Character of the Inside; Two Coupling Channels (March 2026)

The following results were developed in *The Structure of What Happens — General Theory V0.5* [Paz 2026f], Parts XLIX–LIV, and address a question the main body of this paper does not reach.

B.1 — The Gap the Identity Claim Leaves Open

The identity claim (§I.C) dissolves the hard problem of *presence*: why is there experience at all? Answer: because experience IS closed temporal self-reference above threshold, not something added to it. The question presupposed a gap that does not exist.

But the identity claim, as stated, leaves a second question open: **why does experience have this specific character rather than some other?** Why does this organism's inside feel like this — this specific texture, this specific depth, this specific temporal reach — rather than like some other inside? This is the residual content of the what-it-is-like question that presence alone does not answer.

The identity claim entails an answer. If experience is identical to the loop's structure viewed from inside, then the specific character of experience is determined by the specific structure of the loop. What determines the structure? The General Theory (§6.6) identifies three nested layers that together constitute the content of every forward arc above threshold.

B.2 — The Two Coupling Channels: Clarifying $\mathcal{D}_{\text{crit}}$

Before developing the character argument, a precision on the threshold notation used throughout this paper and Addendum A.

Addendum A uses $\mathcal{D}_{\text{crit}}$ for the consciousness threshold without specifying which coupling channel it refers to. There are two:

Curvature channel: $\mathcal{D}_{\text{crit}}^{\text{grav}} = m_s M_{\text{Pl}} H_0/(4\pi^2) \approx 10^{-27}\ \text{m}^{-2}\text{s}^{-1}$ — governs astrophysical

STF activation (binary black hole inspirals). Every macroscopic system, living or not, exceeds this by many orders of magnitude. It does not discriminate between living and non-living systems and is not the consciousness threshold.

Fermion channel: $\mathscr{D}_{\text{crit}}^{\text{bio}} = m_s^3 c^3/\hbar^3 \approx 8 \times 10^{-48}\ \text{m}^{-3}$ — governs consciousness. Its effective condition reduces to $N_{\text{loops}} \geq 1$: at least one closed causal feedback loop with cycle time $\Delta t \leq \tau_c = 3.32$ years within a bounded region. This distinguishes living from non-living systems precisely because it is a topological condition on loop structure, not a density condition on matter. A rock has the same fermion density as a brain — both exceed the coupling-action sourcing condition by 84 orders of magnitude — but a rock has no directed closed causal cycles. The organism does.

Throughout this paper and Addendum A, every reference to "above $\mathscr{D}_{\text{crit}}$" in the biological and consciousness context refers to $\mathscr{D}_{\text{crit}}^{\text{bio}}$ — the fermion channel threshold. Same field, same τ_c, different coupling sector and different formal criterion. (General Theory §2.6; Biology V0.5 Addendum B.1.)

B.3 — What Determines the Character of the Inside

The identity claim states: the inside IS the loop's structure, viewed from within. Therefore the character of the inside — what it is like to be this system — is determined by the specific structure of the loop that is closing. The General Theory (§6.6) identifies three nested layers of that structure.

Layer 1 — The organism's lifetime. The forward arc runs from threshold crossing to death. The specific history of this organism under its own backward constraint is the immediate content of its inside. Irreducibly this organism's — two genetically identical organisms diverge from the first moment of their own HAPPENS, because each runs its own closed loops shaped by its own specific trajectory. The inside at any moment is this organism's path through its own loop, under the constraint propagating backward from its own fixed terminal boundary.

Layer 2 — The code's journey: a tree with extinction bottlenecks. The forward arc is generated by a code that carries four billion years of evolutionary history. Not as a uniform depth — as a tree with a specific branching and bottleneck structure. Mass extinction events are not neutral losses within the STF framework. They are the backward constraint of the code's closure condition operating at its most concentrated, at a branching point: pruning trajectories that could not maintain the chain and forcing a restart from whatever configuration survived. The K-Pg survivors were small generalist mammals. Everything built since is built on that bottleneck configuration.

The inside of any surviving lineage therefore carries not only the accumulated depth of successful selections but the shape of every extinction bottleneck the lineage passed

through, and the specific code configuration preserved at each restart. A bacterial lineage that evolved continuously for four billion years without a major bottleneck carries a different depth structure than a mammalian lineage reset repeatedly by mass extinctions — not less depth, but depth structured differently. The character of the inside is determined by this branching history. What the loop can close around — what distinctions it can make from within, what temporal reach it has, what architecture it runs — is what the code's four-billion-year tree has produced in this lineage.

Layer 3 — The constants that made the code possible. The code runs on chemistry. The chemistry runs on constants. The constants are not neutral background: they are the configuration that survived the cosmic chain's own bottleneck history. Universes whose constants could not produce black holes left no descendants. The cosmic equivalent of mass extinction events — constant-configurations that were sterile, that terminated the chain in that branch — reset the surviving constants toward the marginal configuration that threads the generation-boundary-producing window. The apparent fine-tuning of our constants is the signature of a cosmic lineage that has passed through many such near-extinction events. Precision is a record of near-misses (General Theory §17.11.6).

The organism's inside is ultimately running on the output of a learning process that began before this universe existed.

B.4 — What the Character Question Now Dissolves Into

The specific what-it-is-like of this organism's inside — the residual after the presence question is answered — is determined by the specific content of its forward arc at all three layers simultaneously. The framework does not leave the character of experience unexplained as brute fact. It identifies what carries the character: the organism's own history, under the backward constraint of its death (Layer 1); the code's four-billion-year branching tree, carrying the shape of every extinction the lineage survived (Layer 2); the constants shaped by the cosmic chain's own near-extinctions (Layer 3).

Mary knew everything physical about color vision. What she lacked, within the identity framework, was not a separate fact inaccessible to physics — she lacked the specific structure of the loop closing in her visual cortex, which she could only acquire by running it. When she steps outside and sees red, she does not learn a new fact about a non-physical domain. She crosses the threshold: the loop closes in her, above $\mathscr{D}_{\text{crit}}^{\text{bio}}$, in the specific configuration her code and her cortex make available. What it is like is what that loop is, from inside. The character is the loop's structure. The loop's structure is what four billion years and three layers of depth produced in her lineage.

The explanatory gap closes not by adding phenomenal facts to the physical story but by recognizing that the phenomenal character IS the physical structure of the loop — all the way down, at all three layers, simultaneously.

B.5 — Consequence for §I.C and §X.H.2

§I.C: The identity claim as stated is correct and stands. Addendum B adds the depth dimension: the identity holds not just at the level of loop-closure-versus-presence but at the level of loop-structure-versus-character. The full identity: experience, in its presence and in its specific character, is what the loop is from inside — where the loop's structure includes its evolutionary history and the cosmic history that shaped the constants it runs on.

§X.H.2: The universe's distributed inside is not uniform. It is constituted by local closures above $\mathscr{D}_{\text{crit}}^{\text{bio}}$ throughout cosmic history — each carrying its own three-layer depth, each different from every other because each lineage carries a different branching tree and a different individual history. The universe's inside is distributed, irreducibly diverse, structured by four billion years of evolutionary divergence under common cosmic constants. Not unified as one cosmic experience — real as the aggregate of structurally distinct insides, each permanent as having-been-experienced, each contributing its specific depth to the universe's total distributed interiority.

Addendum **B** *updated March 2026 — see General Theory V2 [Paz 2026f]*

Addendum C — Universe as Black Hole Interior; AdS/CFT as Two-Description Structure (March 2026)

The following results were developed in *The Structure of What Happens — General Theory V0.5* [Paz 2026f], §17.9–17.10, and apply the framework's core structural moves — the two-description identity and the EXISTS/HAPPENS distinction — at the cosmic scale.

C.1 — The Identity Claim at the Generation Boundary: §17.9

This paper's identity claim (§I.C) states: the inside of a closed causal loop above $\mathscr{D}_{\text{crit}}^{\text{bio}}$ and the loop's structural closure are the same thing under two complementary descriptions — from outside, geometric-temporal closure; from inside, experience.

The General Theory (§17.9) applies the same two-description move at the generation boundary of the universe.

The same event, two descriptions:

From the parent universe's interior: a star collapses, crosses the Schwarzschild radius, a singularity forms, an event horizon seals the EXISTS pocket. A black hole forms.

From inside the child universe: EXISTS was forced into HAPPENS. The temporal cascade propagated outward at *c*. A universe began. The Big Bang.

These are not two events. They are one event — one generation boundary — described from two sides. The categorical distinction between the black hole singularity (EXISTS within HAPPENS) and the cosmological singularity (EXISTS generating HAPPENS) is a distinction of perspective, not ontology. Viewed from both sides simultaneously, it collapses into the structural identity: the Big Bang and the black hole singularity are the same event under two complementary descriptions.

The direct parallel to the identity claim:

IDENTITY CLAIM (§I.C)	§17.9
From outside: geometric-temporal closure	From parent universe: black hole formation
From inside: experience	From child universe: Big Bang cascade
Same structure under two descriptions	Same generation boundary under two descriptions
Hard problem dissolves — no gap to bridge	Information paradox dissolves — no information lost
The inside is constitutive of the loop	The child HAPPENS is constitutive of the generation boundary

The hard problem of consciousness dissolved because the presupposition of a gap was false — experience IS the loop structure from inside, not something added to it. The information paradox dissolves for the same reason: the information is not in the Hawking radiation because it was never in the parent universe waiting to be recovered. It IS the child HAPPENS — the information that passed through the generation boundary is the child universe running. Same structural move. Same dissolution. Two scales.

C.2 — The Event Horizon Is the Cosmological Horizon

The event horizon of the parent black hole is the boundary from which no signal escapes to the parent universe. Our cosmological horizon is the boundary beyond which no signal from our universe can travel. These are the same boundary described from two sides.

The constitutive invisibility of the parent universe — why we find ourselves in one universe with no direct access to the parent — is not a contingent limitation. It follows from

the same structural identity: we are inside a generation boundary, on the wrong side of an event horizon. The parent universe is constitutively invisible for exactly the same reason that the organism's inside is constitutively inaccessible from outside the loop. Both are cases of the two-description structure: the same boundary, two incompatible epistemic standpoints.

Consequence for §X.H.2 (Universe's Distributed Interiority):

§X.H.2 established that the universe's distributed inside is real — constituted by every local loop closure above $\mathscr{D}_{\text{crit}}^{\text{bio}}$ throughout the universe's interior. §17.9 adds: this distributed inside is running inside a generation boundary — inside a black hole in the parent universe. The entire distributed interiority that §X.H.2 describes is the child universe's HAPPENS, which is simultaneously the information content of what fell through the parent universe's generation boundary.

This does not diminish the distributed inside. It deepens it. Every local loop closure above threshold, every moment of experience permanently fixed as having-been, is part of the running HAPPENS that the parent generation boundary encoded. The universe's inside is real at two levels: locally, as the aggregate of State 3 systems throughout its history; and cosmically, as the child HAPPENS of a generation boundary event in a larger chain. Both levels simultaneously.

C.3 — AdS/CFT as the Two-Description Structure at the Generation Boundary

The AdS/CFT correspondence [Maldacena 1997] — a gravitational theory in a (d+1)-dimensional Anti-de Sitter bulk is exactly equivalent to a conformal field theory on its d-dimensional boundary — has been regarded as mysterious: why should the bulk's full physics be encoded on its boundary? Why is the duality exact?

The General Theory (§17.10.4) answers both questions with the same two-description move this paper uses for consciousness.

The bulk is HAPPENS. The (d+1)-dimensional interior with gravity, locally-generated time, running causal transactions — the HAPPENS side of the generation boundary.

The boundary is EXISTS. The d-dimensional CFT on the boundary has no gravity, no locally-generated time — it is a theory of the generation boundary's configurations, the EXISTS concentrated at the EXISTS/HAPPENS interface. The conformal symmetry of the boundary theory is what EXISTS looks like: scale-invariant, without temporal asymmetry, without the directionality that HAPPENS introduces.

The duality is exact for the same reason the identity claim is exact. There is no third description from which bulk and boundary could be said to be distinct things. They are one thing — the generation boundary — described from two sides. From inside HAPPENS: the

bulk description, with gravity and time. From the boundary EXISTS: the CFT description, without gravity and without time. Two descriptions. One structure.

The AdS/CFT mystery dissolves in precisely the same way the hard problem dissolves. Both presuppose a gap — between bulk and boundary, between physical structure and experience — that does not exist. Both are cases of the two-description identity applied to one structure at a boundary: the EXISTS/HAPPENS interface in the AdS/CFT case, the closed causal loop above threshold in the consciousness case. Same move. Same dissolution. Same framework.

Addendum C updated March 2026 — see General Theory V2 [Paz 2026f]

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