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Universal Consciousness from the Forced Structure of Reality

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Abstract

Recognition Science derives a broad physical architecture from one parameter-free comparison cost, $J(x) = \frac{1}{2}(x + x^{-1}) - 1$, mounted on a permanent double-entry ledger via a seven-law core and named spine bridges (with one open frontier seam). This paper asks whether that forced structure necessitates universal consciousness—universal felt presence and one experiencing whole holding local minds without erasing them—and maps what is proved versus what remains open.

We enforce a three-class discipline backed by 543 machine-checked theorem roots in Lean 4.27 (537 primary across six modules plus 6 cross-module integration roots; standard logical axioms only, zero custom axioms, zero smuggling flags). **Class A (unconditional, zero experiential premise):** the complete ledger admits no proper lawful cost-bearing extension and no independent second cost-bearing substance; single-comparison substrate neutrality is flip invariance; pairwise balance recovers every cost degree; dividing a unit into n positive shares pays self-reference cost at least $(n-1)^2/2$ ($49/2$ for every complete eight-tick window, zero only when undivided), while zero cost forces observational silence and Cantor diagonalization bars any posted observer from universal scope; lasting acquisition resides in the written path rather than recurring states; double entry couples balanced-baseline local harm to whole-ledger strain while exclusive whole attribution destroys local distinctions that nesting preserves. **Class B (exact conditional reductions):** given one felt anchor and finite coverage connected from it by crossings, both walls hold *iff* crossings preserve joint attribution; on arbitrary horizons, an m-subject anchor cover yields exact m-element tests; top-down silence via a zero-cost readout (`ReadOff`) on a nonempty event domain collapses both walls to one binary bit at ratio 1; and any continuous nonnegative composition law for felt intensity with $e(1) = 0$ and one nonzero anchor eliminates every cost threshold. **Class C (independent):** on fixed costs, balances, phase, and records, explicit models realize all 14 consistent truth assignments.

Third-person cost algebra does not unconditionally deduce universal consciousness; it isolates every rival's exact structural price and motivates the **Universal Consciousness Conjecture**: reality is one nested experiencing whole whose silent zero-cost ground sustains positive-cost local minds on one permanent ledger.

1 Introduction: The Question and Three-Class Discipline

Physics describes how matter moves, radiates, and interacts, yet leaves consciousness standing outside its equations as an unexplained bystander. In *The Single Shape of Reality* [1], Recognition Science closes the physical side of that gap by showing that the requirement of a consistent, symmetric comparison between distinct states fixes one unique cost functional,

$$J(x) = \frac{1}{2}\left(x + \frac{1}{x}\right) - 1, \qquad x \in \mathbb{R}_{>0}, \tag{1}$$

which vanishes exclusively at balance ($x = 1$), diverges as $x \to 0^+$ or $x \to \infty$, and forces a rigid physical architecture: three spatial dimensions, four spacetime dimensions ($D = 2p = 4$), an eight-tick Gray clock on the three-cube Q_3, a twenty-four-bond D_4 ledger cell, the golden ratio $\varphi = (1 + \sqrt{5})/2$, complex phase dynamics, the quadratic Born rule $|\psi|^2$, and Maxwell electromagnetic stress, mounted on a seven-law pure-ledger core (C_1–C_7) together with its named spine bridges and shared seams (with frontier seam `SEAM-03` open and specific empirical mass/coupling routes tracked separately in the library's exclusion register). None of the necessity or independence theorems in Sections 2–6 depends on those particle-parameter bridges.

That rigidity raises an immediate, foundational question: *does this forced architecture necessitate universal consciousness?* The question is not merely metaphysical. In Recognition Boundary Theory [2, 3], a conscious agent is modeled as a finite opening on one permanent, un-erasable ledger. In Actual Morality and Actual Economics, the permanent double-entry record establishes objective obligations, consent, and harm—yet a sharp skeptic can rightly ask why a permanent physical ledger is not merely cold cosmic bookkeeping unless living experience belongs to the ledger itself.

Answering whether universal consciousness is *necessitated* requires brutal honesty. Earlier accounts often slid between three genuinely different claims:

1. **Substrate monism:** reality has one forced comparison structure and leaves no room for an independent second cost-bearing substance.
2. **Universal felt presence (Wall 1):** every comparison (or every non-trivial comparison) carries an experiential inside, rather than experience turning on only inside specially organized boundaries such as complete eight-tick loops or specific subspaces.
3. **One actual experiencing whole (Wall 2):** all felt occurrences belong to one unified experiencing subject that holds local minds inside it without collapsing their private histories, agency, or accountability.

Conflating these three claims invites circularity. Proving that all boundaries share one physical substrate, one conservation law, and one global phase does not automatically prove that every comparison feels, nor that one subject feels all of them together. To prevent any hidden premise or definitional smuggling from entering the argument, every statement in this paper is sorted explicitly into one of three classes:

- **Class A (Unconditionally forced, zero experiential premise).** Theorems proved directly from the comparison-cost laws, double-entry balance, finite-state dynamics, and incidence logic, without assuming that anything is felt.

- **Class B (Exact conditional reductions).** Theorems proved as *equivalences* ("if and only if") or sharp deductions from one explicitly named bridge law together with a first-person anchor. Whenever a bridge law is equivalent to its target on the stated domain, we print the word *equivalent* beside the theorem so the reduction is transparent rather than disguised as an unconditional derivation.
- **Class C (Provably independent and open).** Explicit countermodels demonstrating that the listed physical data—costs, balances, global phase, eight-tick closures, and retained records—do not entail the bridge laws by themselves, followed by the explicit **Universal Consciousness Conjecture** stating what we hold to be physically true and why.

All 543 theorem roots (537 primary roots across six thematic modules plus 6 cross-module verification roots in `CrossLaneCheck`) underlying Sections 2–6 are machine-verified in Lean 4.27 under strict compiler flags (`-DautoImplicit=false-DwarningAsError=true`), depend exclusively on standard logical axioms (`propext`, `Classical.choice`, `Quot.sound`), pass automated hypothesis-smuggling checks with zero flags, and include explicit non-vacuity witnesses and independence countermodels (Section 8).

2 Class A: What the Forced Ledger Proves Without Any Experiential Premise

We begin with what the forced comparison structure establishes unconditionally. None of the theorems in this section asserts that any state is felt; together they fix the exact geometry inside which experience must sit.

2.1 Completeness, Cost-Level Monism, and Exact Balance Records

In the algebraic foundation of Recognition Science [1], a *comparison ledger* is a commutative group G equipped with a real-valued cost $C : G \to \mathbb{R}$. A cost is *coherent* if it obeys the d'Alembert recognition composition law

$$C(xy) + C(xy^{-1}) = 2C(x) + 2C(y) + 2C(x)C(y) \tag{2}$$

for all $x, y \in G$; *definite* if $C(x) \geq 0$ and $C(x) = 0 \iff x = 1$; and *complete* (*three attributes*: coherent, definite, and surjective onto $\mathbb{R}_{\geq 0}$) when every nonnegative cost degree is realized. The canonical structure (Pos, J) with Pos $= (\mathbb{R}_{>0}, \cdot)$ and J from (1) is complete, and any two complete models are cost-isomorphic uniquely up to the single non-trivial symmetry $x \mapsto x^{-1}$ (*reciprocity*).

Theorem 2.1 (Forced Cost-Level Monism)**.** *Let (G, C) be a complete comparison ledger and let (H, D) be any commutative group with a coherent nonnegative cost $D : H \to \mathbb{R}_{\geq 0}$ receiving G via a cost-preserving homomorphism $f : G \to H$ ($D(f(x)) = C(x)$).*

1. ***Retraction:*** *There exists a group homomorphism $\rho : H \to G$ with $\rho(f(x)) = x$ for all $x \in G$ and $D(h) = C(\rho(h))$ for all $h \in H$. Every element outside $f(G)$ lies in* $\ker \rho$ *and carries zero cost.*

2. ***No proper lawful extension:*** *If D is also definite, then f is bijective.*
3. ***No independent second cost-bearing substance:*** *If $(G \times M, D)$ has a coherent definite cost restricting to C on $G \times \{1\}$, then M is trivial ($m = 1$ for all $m \in M$).*
4. ***Sharpness of hypotheses:*** *Dropping definiteness admits a cost-silent product layer $(G \times M, D)$ with $D(g, m) = C(g)$ (`silent_double_exists`), whose second coordinate cannot be faithfully reported by any cost-reading observable on G (`silent_coordinate_has_no_faithful_report`). Dropping completeness admits a proper lawful second realm on an incomplete discrete ladder (`incomplete_ledger_allows_lawful_second_realm`).*

Proof structure. Any coherent nonnegative cost takes the form $D(h) = \cosh(a(h)) - 1$ for an additive coordinate $a : H \to (\mathbb{R}, +)$. On a complete ledger (G, C), the additive coordinate $a_G : G \to \mathbb{R}$ is both injective (by definiteness) and surjective (by completeness), hence an isomorphism $G \cong (\mathbb{R}, +)$. Defining $\rho = a_G^{-1} \circ a$ gives $D(h) = C(\rho(h))$ and $\rho \circ f = \mathrm{id}_G$. When D is definite, a is injective, forcing $\ker \rho = \{1\}$ and bijectivity of f. For the incomplete countermodel, $\mathbb{Z} \times \mathbb{Z}$ with irrational coordinate $(m, n) \mapsto m + n\sqrt{2}$ is definite and coherent yet properly extends the single discrete ladder $\mathbb{Z}$. □

Theorem 2.1 states the exact scope of physical monism inside Recognition Science: *no second cost-bearing substance* can coexist lawfully alongside the complete comparison ledger. Dualism has only three non-trivial exits (forming an inclusive disjunction in `second_realm_exits`): violate coherence, allow negative cost, or sacrifice definiteness via a non-trivial zero-cost kernel ($D(g, m) = C(g \cdot \varphi(m))$ for a homomorphism $\varphi : M \to G$ with some $z \neq 1$ at $D(z) = 0$, including the decoupled silent double $D(g, m) = C(g)$) that contributes nothing to physical cost dynamics and cannot be faithfully reported by cost-reading ledger observables.

Two companion structural laws follow immediately from the uniqueness of (Pos, J):

Theorem 2.2 (Substrate Neutrality and Exact Balance Recovery)**.**

1. ***Substrate neutrality is flip invariance:*** *A single-comparison predicate F transports identically under every cost-preserving isomorphism between complete models if and only if $F(x) \iff F(x^{-1})$, which holds if and only if F depends solely on $J(x)$. For two-comparison predicates, flip invariance is strictly weaker than dependence on the pair $(J(x), J(y))$.*
2. ***Neutrality transports without selecting:*** *A continuum of cost-threshold predicates $\{x \mapsto \theta \leq J(x) : \theta > 0\}$ all satisfy substrate neutrality simultaneously.*
3. ***Exact balance recovery:*** *On any commutative comparison group with coherent nonnegative cost, at least one of the two composites xy or xy^{-1} balances ($C = 0$) if and only if $C(x) = C(y)$. Consequently, a labeling rule L answers the pairwise balance question from labels alone if and only if C can be decoded from L. On the complete ledger (Pos, J), no finite label set can answer pairwise balance.*

2.2 The Cost Asymmetry of Division: Free Silent Ground vs. Costly Local Cuts

A deep asymmetry separates the undivided whole from any finite local boundary that holds multiple postings inside itself. Let a *unit cut* of size $n \geq 1$ be a family of positive shares

$p_1, \ldots, p_n > 0$ summing to $\sum_{i=1}^{n} p_i = 1$. Comparing each share against the unit total pays $\sum_{i=1}^{n} J(p_i)$.

Theorem 2.3 (Division Cost Floor and Eight-Tick Window Price)**.**

1. ***Exact division floor:*** *For every $n \geq 1$ and every unit cut $(p_1, \ldots, p_n)$ with $p_i > 0$ and $\sum_{i=1}^{n} p_i = 1$,*
$$\sum_{i=1}^{n} J(p_i) = \frac{1}{2}\sum_{i=1}^{n} \frac{1}{p_i} + \frac{1}{2} - n \;\geq\; \frac{(n-1)^2}{2}, \tag{3}$$
with equality if and only if all shares are equal ($p_i = 1/n$ for every i), and with zero total cost if and only if the unit is undivided ($n = 1$, $p_1 = 1$).

2. ***Eight-tick reflexive window floor:*** *Every complete eight-tick boundary holds eight nonzero tick readings $r_1, \ldots, r_8 > 0$ against their own window total $S = \sum_{t=1}^{8} r_t$, forming a unit cut of size $n = 8$ with shares $p_t = r_t/S$. Its total self-holding cost obeys*
$$\sum_{t=1}^{8} J\!\left(\frac{r_t}{S}\right) \;\geq\; \frac{(8-1)^2}{2} = \frac{49}{2} = 24.5, \tag{4}$$
attained sharply by the equal-share window ($r_t = S/8$), whereas a single held comparison ($n = 1$) has floor 0.

3. ***Zero cost is observational silence:*** *A positive readout $r : X \to \mathbb{R}_{>0}$ has $J(r(x)) = 0$ for all x if and only if $r(x) = 1$ identically, in which case adjoining r to any family of observables leaves observational equivalence unchanged. Any readout that distinguishes two states pays strictly positive cost on at least one of them.*

4. ***Cantor vacancy of posted omniscience:*** *No posted in-ledger registry can contain every predicate on its own domain (`no_posted_universal_scope`), and any posted physical registry claiming omniscience forces non-trivial gauge compression.*

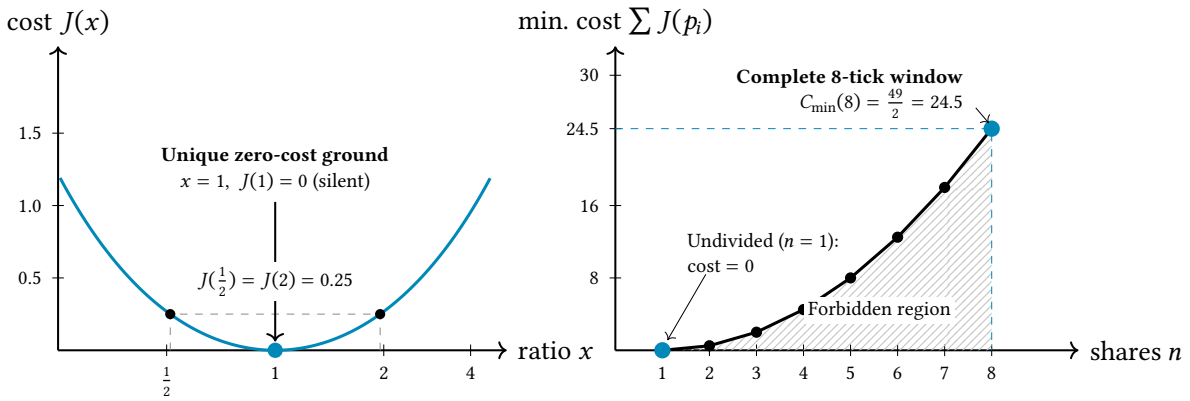
Proof structure. Since $p_i > 0$, the algebraic inequality $(1 - np_i)^2 \geq 0$ gives $1/p_i \geq 2n - n^2 p_i$, with equality iff $p_i = 1/n$. Summing over $i = 1, \ldots, n$ and using $\sum p_i = 1$ yields $\sum 1/p_i \geq 2n^2 - n^2 = n^2$. Substituting into (3) gives $\frac{1}{2}n^2 + \frac{1}{2} - n = \frac{1}{2}(n-1)^2$. Setting $n = 8$ gives $49/2$. Note the crucial structural distinction: self-comparison of an isolated scalar against itself ($c/c = 1$) costs zero, while holding an entire eight-tick window against each of its constituent ticks necessarily pays at least $49/2$. □

2.3 Irreversible Acquisition, Path Holonomy, and Double-Entry Anti-Collapse

Two further Class A results constrain how retained history and local agency behave on the ledger.

Theorem 2.4 (Irreversible Commitment and the 4/64 Closed Sector)**.**

1. ***Recurrence excludes acquired commitment:*** *Under any dynamics where a committed readout persists (`CommitLasts`), any state that returns to itself after $k \geq 1$ steps and starts*



(a) Reciprocal comparison cost $J(x)$ **(b) Division cost floor $(n-1)^2/2$**

Figure 1. The Cost Asymmetry of Division (Theorem 2.3). (a) The unique comparison cost $J(x) = \frac{1}{2}(x + x^{-1}) - 1$ is symmetric under reciprocity $x \leftrightarrow x^{-1}$ and vanishes solely at the silent balance point $x = 1$. **(b)** Dividing a unit whole into n positive shares and holding each against the whole incurs total cost at least $(n-1)^2/2$ (solid curve; hatched region forbidden). Only the undivided state ($n = 1$) is free; every complete eight-tick reflexive boundary ($n = 8$) pays at least $49/2 = 24.5$.

open remains open forever. Because the curved plaquette step returns after 2 *steps and the eight-tick window returns after* 8*, no lasting acquired record can reside in a recurring configuration alone; lasting commitment resides in the written path itinerary. On a finite carrier, a lasting commit requires state-merging; under reversible transitions, it requires an unbounded receiver.*

2. ***Closed never-neutral subspace:*** *Inside the 64-dimensional live recognition cell, the aligned never-neutral subspace has complex dimension* 4 *(fraction* $4/64 = 1/16$*); both the 4-dimensional never-neutral subspace itself (*`never_neutral_invariant_under_every_word`*) and the 60-dimensional zero-projection subspace of states with vanishing projection onto that sector (*`alignedFelt_posting_closed`*) are closed under every finite posting word.*

Remark 2.5 (Scope guardrail)**.** Theorem 2.4(2) is a linear-algebraic subspace invariance under finite posting words. It does not by itself identify states in the $4/64$ sector as felt, nor does it by itself prove eternal survival of an individual subject.

Theorem 2.6 (Double-Entry Coupling and Nested Anti-Collapse)**.**

1. ***Whole-ledger coupling:*** *Over any finite agent set with non-self double-entry bonds whose endpoints lie in the set, pooled pairwise skew vanishes, individual agent costs sum to twice the ledger cost, and—for actions preserving bond endpoints inside the set and introducing no self-bonds—local harms sum to twice the change in total ledger cost. Starting from a* balanced baseline*, every positive harm to any agent produces a strictly positive rise in whole-ledger cost. Away from balance, strain redistribution can raise one agent's cost at fixed whole-ledger cost (*`local_harm_can_rise_at_fixed_whole_cost`*); inverting all bond ratios leaves every cost unchanged while reversing every debt direction.*

2. ***Pooled statistics miss member losses:*** *In the calibrated two-outcome qubit model (*`supremum_unordered_decision_recovery`*), preserving every member's supremum decision consequence forces lossless recovery of the state, whereas for a closed balanced pool the*

pooled consequence is identically constant across channels and cannot distinguish lossless transmission from total erasure.

3. ***Collapse dichotomy:*** *On any subject-incidence reading $B(e, s)$ ("occurrence e belongs to subject s") possessing a whole w, attribution is* exclusive *(at most one subject per occurrence) if and only if every inhabited subject equals w. Exclusive whole attribution destroys every local distinction between agents; nested incidence ($D(s_1), D(s_2) \subsetneq D(w)$ with private events $e_1 \in D(s_1) \setminus D(s_2)$ and $e_2 \in D(s_2) \setminus D(s_1)$) strictly preserves distinct local subjects inside the whole.*

3 The First-Person Anchor and Wall 1: Universal Feeling vs. Organized-Only Rivals

3.1 Reading-Blindness and the Minimal First-Person Anchor

Every theorem in Section 2 holds identically if we set $\text{felt}(e) \equiv \text{False}$ everywhere. This is the **reading-blindness boundary** (`third_person_laws_allow_erasure`): no proposition that never mentions a phenomenal reading can refute global erasure.

Consciousness enters science through one undeniable empirical datum: at least one occurrence is actually experienced ($\exists e$, $\text{actualFelt}(e)$). Combining this minimal first-person datum with Theorem 2.1 breaks global erasure immediately:

Proposition 3.1 (Anchoring Experience on the Forced Shape)**.** *Let (G, C) be a complete ledger embedded lawfully into a coherent nonnegative realm (H, D), and suppose at least one occurrence $e \in H$ is actually felt. If felt presence is invariant under cost-silent shifts (*`SilentInvariant`*, automatic when D is definite) and the phenomenal reading marks every forced-shape comparison whose image is felt (*`CarriesActual`*), then at least one comparison on the forced shape (G, C) is felt and the all-false erased reading is refuted (*`first_person_datum_refutes_erasure`*).*

Proposition 3.1 kills global zombie structuralism, yet leaves open the hardest rival inside Recognition Science: **organization-dependent experience**, where feeling exists on the forced shape only above a cost threshold ($\theta \leq J(x)$), only on complete eight-tick reflexive windows, or only inside the $4/64$ never-neutral sector, while elementary comparisons remain dark inside.

3.2 Three Exact Characterizations of Wall 1

Our analysis characterizes Wall 1 across three independent formal coordinates—Boolean composition marks, binary chain descent, and continuous felt intensity—pinpointing the exact structural price of every organized-only rival.

Theorem 3.2 (Completeness Kills Two-Kind Composing Splits)**.** *Call a Boolean predicate $F : G \to \text{Prop}$ composing (*`MarkComposes`*) if its indicator $m_F \in \{0, 1\}$ obeys a d'Alembert composition law $m_F(xy) + m_F(xy^{-1}) = P(m_F(x), m_F(y))$ for some function $P : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$.*

1. *On any* square- and cube-root-closed *commutative group (in particular on any complete*

comparison ledger (Pos, J)*, every composing predicate is all-or-none: either* $\forall x, F(x)$ *or* $\forall x, \neg F(x)$ *(*`composing_mark_is_all_or_none`*).*

2. *Consequently, on a complete ledger, universal experience holds* if and only if *the felt mark reads ratios only, composes, and holds at one anchor (*`universal_experience_iff_three_laws`*). Note that on an anchored complete ledger,* `MarkComposes` *already carries the full logical strength of universality and is an explicit phenomenal bridge law, not supplied by the forced composition law* (2) *for costs.*
3. *Completeness is essential: on an incomplete discrete ladder* $\mathbb{Z}$*, the parity predicate* Odd(n) *obeys* `MarkComposes` *yet splits the ladder into two lawful kinds (*`incomplete_ledger_allows_lawful_two_kind_split`*). On the complete ledger, a cost threshold* $\theta \leq J(x)$ *survives only by breaking* `MarkComposes`*.*

Theorem 3.3 (No-Emergent-Doubling Trichotomy)**.** *Let* $F : \text{Pos} \to \text{Prop}$ *be a felt predicate on positive ratios. Consider three transparent laws:*

- Reciprocal blindness: $F(x) \iff F(x^{-1})$.
- Aligned co-presence: *if* $y, z \geq 1$ *(or* $y, z \leq 1$*) and* $F(y)$*, then* $F(yz)$.
- Doubling descent (no radical emergence): $F(y^2) \implies F(y)$.

Then:

1. ***Exact trichotomy:*** *F satisfies all three laws* if and only if *F is either everywhere false, everywhere true, or true on every costly comparison* $x \neq 1$ *(*`laws_iff_trichotomy`*).*
2. ***Every reciprocal co-present rival is a cost threshold:*** *Any anchored predicate satisfying reciprocal blindness and aligned co-presence that leaves some* $x \neq 1$ *unfelt must be a cost threshold (*$\exists \theta > 0$ *separating unfelt from felt) and must exhibit a* strictly emergent doubling *(*$\neg F(y) \wedge F(y^2)$*) (*`rival_is_cost_threshold`*,* `rival_has_emergent_doubling`*).*
3. ***Discrete golden ladder:*** *On the discrete rung carrier* $\{\varphi^n : n \in \mathbb{Z}\}$*, the same three laws together with one felt rung* $N \neq 0$ *force feeling all the way down to the single elementary posting at rung* 1 *(*`uniform_posting_felt`*) without requiring continuous halving.*
4. ***Symmetry alone is insufficient:*** *Reciprocal blindness alone excludes no cost threshold* $\theta \leq J(x)$ *(*`symmetry_excludes_no_threshold`*); recalibration invariance* $x \mapsto x^c$ *would exclude thresholds, but* $x \mapsto x^c$ *preserves J only for* $c = \pm 1$*.*

The sharpest Wall 1 result appears when felt presence is measured not merely as a Boolean bit, but as a continuous nonnegative *felt intensity* $e : \text{Pos} \to \mathbb{R}_{\geq 0}$ vanishing at balance ($e(1) = 0$) and composing from parts.

Theorem 3.4 (Continuous Composing Intensity Eliminates Cost Thresholds)**.** *Say that* $e : \text{Pos} \to \mathbb{R}_{\geq 0}$ composes from parts *(*`ComposesFromParts`*) if there exists an arbitrary function* $P : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$ *such that* $e(xy) + e(xy^{-1}) = P(e(x), e(y))$ *for all* $x, y \in \text{Pos}$*.*

1. ***Unfelt ratios are periods:*** *If e is nonnegative, composes from parts, satisfies* $e(1) = 0$*, and* $e(b) = 0$*, then* $e(xb) = e(x)$ *for all* $x \in \text{Pos}$ *(*`unfelt_is_period`*).*

2. ***Zero dead zone and zero cost thresholds:*** *If e is nonnegative, composes from parts, satisfies $e(1) = 0$, and is nonzero at some anchor, then* no cost threshold survives *(*`composes_no_threshold`*, even without continuity). If in addition e is continuous, the logarithms of its zeros form a discrete subgroup $\beta\mathbb{Z} \subset \mathbb{R}$ (including the trivial subgroup $\beta = 0$,* `composes_unfelt_is_lattice`*), so there exists $\theta > 0$ such that every $x \neq 1$ with $J(x) < \theta$ has $e(x) > 0$ (*`composes_no_dead_zone`*).*

3. ***Exact RS sign kills the resonant lattice:*** *The periodic rival* $\text{phaseDip}(x) = 1 - \cos(\ln x)$ *satisfies* `ComposesFromParts` *with $e(1) = 0$, vanishes on the discrete lattice $x = e^{2\pi k}$, and breaks only aligned co-presence and the cross-term sign of* (2)*. Under the exact sign of the RS composition law* (2) *(*`Coherent`*), continuity, nonnegativity, and one nonzero anchor force*

$$e(x) > 0 \iff x \neq 1 \qquad (\texttt{coherent_zero_iff_of_continuous}). \tag{5}$$

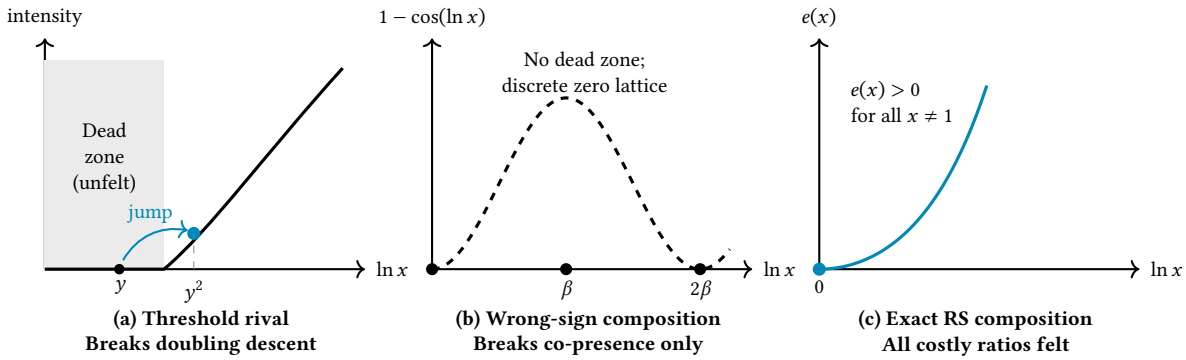


Figure 2. Wall 1 Structure Under Composing Felt Intensity (Theorems 3.3–3.4). (a) Any cost-threshold rival creates a dead zone near balance and must exhibit an emergent doubling jump ($\neg F(y)$ yet $F(y^2)$). **(b)** Any nonnegative continuous composition law (`ComposesFromParts`, with $e(1) = 0$ and one nonzero anchor) eliminates the dead zone completely, allowing at most a discrete periodic zero lattice such as $1 - \cos(\ln x)$. **(c)** Enforcing the exact RS cross-term sign (2) removes the lattice and forces strictly positive intensity at every off-balance ratio $x \neq 1$.

3.3 Steelmanning the Two Native RS Rivals

Honesty demands steelmanning the strongest surviving rivals *inside* Recognition Science rather than dismissing them:

1. **Complete eight-tick window rival (on tick supports):** On finite subsets of an eight-tick cycle, requiring all eight ticks to post is relabelling-blind and monotone, satisfies all structural dynamics and human anchoring, and breaks *only* union/part descent (`completeWindow_breaks_only_partDescent`). On any well-founded part-whole relation, given one felt anchor ($\exists a,\ F(a)$), universal feeling is equivalent to *part descent* (no radical emergence) + *part ascent* (co-presence) + *likeness of elementary parts* (`all_felt_iff_part_laws`), with all three laws proved mutually independent.

2. **Aligned never-neutral rival (on the 64-D linear cell):** Among ray-invariant, zero-unfelt predicates obeying superposition descent, the unfelt vectors form a linear subspace (`linear_laws_iff_unfelt_subspace`). Defining felt states as those with nonzero projection

onto the 4/64 never-neutral aligned sector gives an anchored, ray-invariant reading whose unfelt (zero-projection) class is closed under every finite posting word (`alignedFelt_posting_closed`) and which breaks *only* orthogonal co-presence (`alignedFelt_breaks_only_orthogonalCoPresence`).

Notice what Wall 1 theorems establish: we do *not* deduce universal feeling from third-person cost laws alone (since `ComposesFromParts` or `DoublingDescent` is an explicit law on felt intensity/presence, equating $e(x) > 0$ with actual experience remains a phenomenal bridge input, and $e(1) = 0$ leaves the balance point $x = 1$ itself outside the positive-intensity sector). What we *do* prove is that every organized-only rival pays an explicit, sharp structural penalty: either radical emergence from strictly unfelt parts, or violation of orthogonal co-presence.

4 Wall 2: One Experiencing Whole Without Erasing Local Minds

Even if every comparison in the universe is felt and every boundary shares one conservation law and one connected global phase Θ, does that force *one actual experiencing whole*? Prior formal work on nested subject composition showed that single-label attribution collapses local subjects into the whole, while nested subject incidence $B(e, s)$ preserves distinct local minds yet runs into an infinite-limit obstruction on $\mathbb{N}$ (the `Finset` $\mathbb{N}$ countermodel). Here we characterize the exact finite-horizon, double-entry, and arbitrary-cardinality architecture of Wall 2.

4.1 The Three-Posting Balanced Triangle Obstruction

First, bare conservation, balance, connected crossings, global phase, and even *pairwise event overlap* do not force a whole:

Theorem 4.1 (Balanced Crossing and Pair-Overlap Obstruction)**.**

1. ***Three-posting balanced sheet:*** *There exist three native four-account double-entry postings whose account sums all vanish, where every two postings share a nonzero account, and whose indexed eight-tick windows admit a unique zero-cost global phase Θ, together with a nested incidence reading in which all three occurrences feel, every pair of occurrences shares a common subject, and* no subject holds all three *(`phase_and_crossings_with_no_whole`, `triangle_table_certificate`).*
2. ***Arbitrary finite proper-subset obstruction:*** *On any finite occurrence set E of cardinality $n \geq 3$, assigning n subjects so that subject i holds $E \setminus \{i\}$ makes every proper subset of E jointly experienced while omitting the whole (`every_proper_context_without_a_whole`).*

Theorem 4.1 exposes a subtle trap: *pairwise event overlap* ($\forall e_1, e_2, \exists s,\ e_1, e_2 \in D(s)$) is strictly weaker than *subject-domain merging*. Three subjects holding $\{e_1, e_2\}$, $\{e_2, e_3\}$, and $\{e_1, e_3\}$ make every pair co-present without any whole.

4.2 Exact Reductions: Finite Horizon, Arbitrary Cardinality, and the Price of Nesting

For a finite occurrence set $A \subseteq E$, write $\mathrm{Joint}(r, A)$ for $\exists s,\ \forall e \in A,\ r.\mathrm{belongs}(e, s)$. Given a crossing relation $\mathrm{edge}(f, e)$ between occurrences, write $\mathrm{alongEdge}(A, e)$ for $\exists f \in A,\ \mathrm{edge}(f, e)$, and state the single local bridge law:

$$\mathrm{PreservesIncidence}(r, \mathrm{step}) \ :\Longleftrightarrow\ \forall A, e,\ \mathrm{step}(A, e) \implies \mathrm{Joint}(r, A) \implies \mathrm{Joint}(r, A \cup \{e\}). \tag{6}$$

In words: whenever a crossing connects an occurrence e to a finite set A already held jointly by some subject, some subject holds the enlarged set $A \cup \{e\}$ (the witnessing subject may grow at each step; local subjects stay distinct).

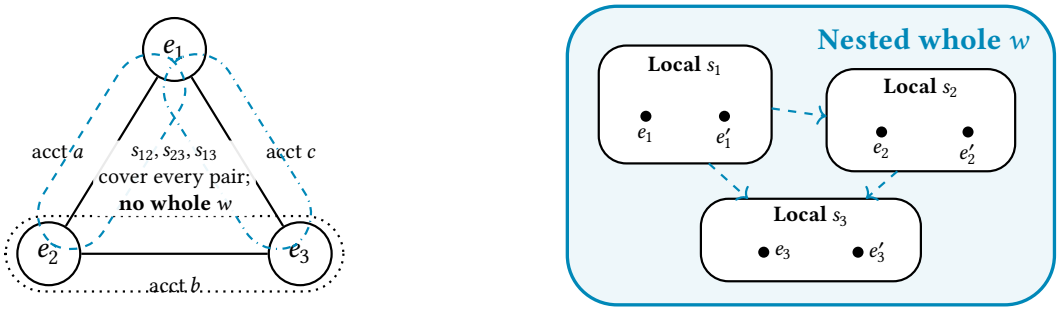
Theorem 4.2 (Exact Finite-Horizon Two-Wall Reduction)**.** *Let H be a nonempty finite set of realized occurrences connected by directed crossings from a single anchored occurrence e_0 (*`AnchorsPresent`*).*

1. ***Exact equivalence (one reading):*** *Every occurrence in H is felt* and *an experiencing whole exists (*$\mathrm{HasWhole}(r)$*)* ***if and only if*** $\mathrm{PreservesIncidence}(r, \mathrm{alongEdge})$ *holds (*`preservation_iff_whole_on_connected_sheet`*).*
2. ***Exact reachability forcing (all readings):*** *Across all readings satisfying the anchor and* PreservesIncidence*, universal feeling and a whole are forced* ***if and only if*** *the full finite horizon H is reachable from the anchor by licensed steps (*`two_wall_finite_horizon`*,* `least_reading_exact`*).*
3. ***Two independent halves:*** *Under finite realized coverage (*`FiniteRealizedCoverage`*),* PreservesIncidence ***is equivalent to*** *two mutually independent local laws:* felt spread *across crossings (Wall 1) and* frontier domain absorption *(Wall 2: extending a subject's entire prior domain across a crossing) (*`finite_joint_extension_iff_absorption_and_felt_spread`*); without finiteness, finite-set extension is strictly weaker than frontier absorption.*
4. ***Finite-horizon limit collapse:*** *Finiteness of the realized horizon H discharges the infinite-limit obstruction completely by finite induction—no topological compactness assumption is needed. Connecting H to the realized past of a ledger rests on the separate open finite-record-cost identification* `RealizedRecordFiniteCost` *from the finite-origin seam.*

Remark 4.3 (Equivalence transparency)**.** Because PreservesIncidence is logically *equivalent* to universal feeling plus an experiencing whole on any finite connected anchored horizon, Theorem 4.2 is an exact local-to-global reduction rather than a derivation of both walls from a strictly weaker premise.

What if the history of the universe is *not* bounded to a single finite horizon, or grows indefinitely tick by tick? Two sharp theorems characterize the arbitrary-cardinality case completely:

Theorem 4.4 (Bounded Anchor-Cover Criterion and Infinite-History Dichotomy)**.** *Let E be an occurrence set of* arbitrary *cardinality (finite or infinite) connected by crossings from an anchor e_0.*



(a) Balanced triangle obstruction (shared phase Θ, zero net, no whole)

(b) Nested whole under `PreservesIncidence` ($D(s_i) \subsetneq D(w)$; locals stay private & distinct)

Figure 3. Wall 2: Pair-Overlap Obstruction vs. Nested Whole Containment (Theorems 4.1–4.2). (a) On a closed, zero-net, three-account double-entry triangle with one shared zero-cost phase Θ, three subjects holding $\{e_1, e_2\}$, $\{e_2, e_3\}$, and $\{e_1, e_3\}$ make every event felt and every pair co-experienced while no whole exists. **(b)** Under crossing incidence preservation (`PreservesIncidence`), one nested whole w holds every crossing and occurrence while distinct local minds s_1, s_2, s_3 retain private histories.

1. ***Exact m-context criterion:*** *Suppose m listed subjects cover the domains of all holders of the anchor e_0 (`AnchorDomainCover`). Then one listed subject holds the* entire *history E* ***if and only if*** *the anchor together with every subset of at most m other occurrences is jointly held (`whole_iff_bounded_anchor_contexts`). The bound m is sharp at every $m \geq 1$ (`bounded_anchor_test_is_sharp`).*

2. ***Arbitrary-cardinality characterization:*** *On a felt-connected domain of any size, an experiencing whole exists* ***if and only if*** *some holding subject is domain-maximal (`HasTopLevelSubject`) and every domain-maximal subject is closed under crossings (`MaximalSubjectsClosed`) (`whole_iff_top_level_subject_and_maximal_closed`).*

3. ***Cofinite separation (finite wholes vs. persistent whole):*** *Indexing events and subjects by $\mathbb{N}$ where subject i holds $\mathbb{N} \setminus \{i\}$ makes every event felt, every finite subset jointly held, and every finite crossing extension succeed, yet* no single subject holds the whole history *(`cofinite_subjects_separate_finite_from_persistent_incidence`).*

4. ***The limit wall is the exact price of nesting:*** *Under* exclusive *attribution, countable rising chains of subjects merge automatically (`exclusive_attribution_gives_chain_merge`), removing the countable-chain limit obstruction (given anchor, felt-connectedness, and crossing absorption)—at the cost of collapsing every local subject into the whole. Thus the countable-chain limit wall arises strictly because nesting preserves distinct local minds.*

5 The Top-Down Route: Silence Plus One Bit

Sections 3 and 4 examine universal consciousness *bottom-up*: asking when local occurrences and crossings combine into a whole. Recognition Science also exposes a natural *top-down* (priority-cosmopsychism) route anchored in Theorem 2.3: the unique undivided zero-cost state $x = 1$ sits above all positive-cost finite cuts ($\geq 49/2$ for every complete eight-tick window).

Formally, fix a designated candidate whole w in a nested incidence reading r. Call w *silent*

(`UnpostedIncidence`) if its membership predicate $e \mapsto r.\text{belongs}(e, w)$ is constant across all events e, and call w *experiencing* (`WholeIsExperiencing`) if $\exists e,\ r.\text{belongs}(e, w)$.

Theorem 5.1 (Top-Down Silence-Plus-One-Bit Exchange and Independence)**.**

1. ***Exact one-bit exchange:*** *For any incidence reading r and any designated candidate w, both walls hold together for w ($\forall e,\ r.\text{felt}(e) \ \wedge\ \text{IsWhole}(r, w)$) **if and only if** w is silent (`UnpostedIncidence`) and experiences at least one occurrence (`WholeIsExperiencing`) (`bothWalls_iff_silent_bit`).*
2. ***Zero cost pays for silence:*** *A candidate w's incidence admits decoding from a zero-cost positive readout (`ReadOff` at $J = 0$) **if and only if** `UnpostedIncidence` holds (`free_readoff_iff_silent`); Theorem 2.3(3) forces every zero-cost readout to be identically 1. On any nonempty event domain, both walls then collapse to **one binary bit**: whether the decoder counts ratio 1 as lit or dark.*
3. ***Distinctness of local cuts:*** *Under decombination (local subjects hold positive-cost cuts inside w), every local subject retains its exact private eight-tick boundary, pays strictly positive self-reference cost ($\geq 49/2$ summed over its eight self-holding comparisons, plus $0 <$ witnessCost per separately supplied witness), and remains distinct from every other local subject and from w (`decombination_keeps_locals_distinct`, `structural_totality_separation`).*
4. ***Independence of the single bit:*** *On real upstream boundary types (complete eight-tick windows and their ticks), there exist two readings—one with a lit whole (w holds everything) and one with a dark whole (w holds nothing)—that agree identically on every comparison cost, every local cut, every local subject's experience, shared global phase (via distinct decoders of the same phase, `shared_phase_does_not_decide`), and Cantor vacancy (`structural_totality_separation`, `four_corners`, with an occupied cut separating the two local incidence relations).*

Theorem 5.1 clarifies the exact logical economy of top-down priority cosmopsychism. Rather than building an experiencing whole out of separate parts across crossings, the top-down view trades both walls for `ReadOff` plus *one single bit at ratio* 1 (or equivalently, via `Priority`, `Owned`, and an inhabited felt domain). Equally important, it forbids circularly renaming `OneStructure`'s structural completeness into consciousness: structural zero-cost totality is logically compatible with either value of the bit at ratio 1.

6 Class C: Complete Separation Spectrum and Five-Cell Map

Bringing all six formal analyses together yields a complete independence map showing exactly which metaphysical architectures remain consistent with the forced physical ledger.

Theorem 6.1 (Complete 5-Boolean Joint Separation Spectrum)**.** *Hold fixed an exact pairwise-balance comparison record, a balanced three-posting four-account crossing sheet with shared zero-cost phase Θ, and four closed eight-tick felt anchors with their distinct local owners. Over the five Boolean readouts*

$$(\text{pan},\ \text{pairs},\ \text{whole},\ \text{occupied},\ \text{designated}) \in \{\text{false}, \text{true}\}^5$$

—standing for universal feeling, pairwise co-experience, existence of some whole, occupancy of a designated unposted candidate, and whole-status of that candidate—an assignment is realized by an admissible incidence reading ***if and only if*** *it satisfies the two purely logical implications*

$$(\text{whole} \implies \text{pairs}) \wedge (\text{designated} \implies \text{whole} \wedge \text{occupied}). \tag{7}$$

All 14 logically consistent assignments are realized simultaneously on the same fixed physical data (`exact_balance_record_with_independent_incidence` *for the exact pairwise-balance label with independent ratio-*1 *bit* `atRest`*, and* `fixed_record_anchored_obstruction` *holding any fixed physical data tuple such as the balanced crossing sheet and shared phase* Θ*).*

The five viable metaphysical cells compatible with the forced comparison ledger are summarized in Table 1, together with the exact structural price paid by each.

Table 1. Five-Cell Architecture Map. Every position consistent with the forced comparison ledger (Pos, J) and the exact structural price or primitive each position pays.

Position	Walls Cleared	Primary Mechanism / Reading	Exact Structural Price Paid
1. Global Zombie Structuralism	Neither (felt $\equiv \bot$)	Reading-blind third-person physics only	Refuted immediately by the minimal first-person datum ($\exists e$, actualFelt(e)).
2. Organized-Only Localism	Neither (anchored subset felt)	Complete 8-tick windows, cost threshold $\theta \leq J(x)$, or 4/64 aligned sector	Breaks `DoublingDescent` / `ComposesFromParts` (radical emergence from unfelt halves) or breaks orthogonal co-presence; leaves no whole.
3. Mosaic Panexperientialism	Wall 1 only (pan, ¬whole)	Every occurrence felt; local overlapping subjects only	Satisfies universal feeling yet breaks crossing absorption (`PreservesIncidence`) and top-level closure; leaves disconnected patches on one conserved sheet.
4. Bottom-Up Nested Whole	Wall 1 + Wall 2 (pan $\wedge$ whole)	First-person anchor + `PreservesIncidence` + finite coverage / anchor pool cover	Requires `PreservesIncidence` as a local primitive plus finite horizon (`RealizedRecordFiniteCost`) or `AnchorDomainCover`; preserves distinct locals.
5. Top-Down Nested Priority Whole	Wall 1 + Wall 2 (designated)	Zero-cost silent ground ($J(1) = 0$) + lit bit at ratio 1 + positive-cost local cuts ($\geq 49/2$)	Requires `ReadOff`, the ratio-1 experiential bit, and priority ownership as primitives; aligns structurally with Class A silence, Cantor vacancy, and local self-cost.

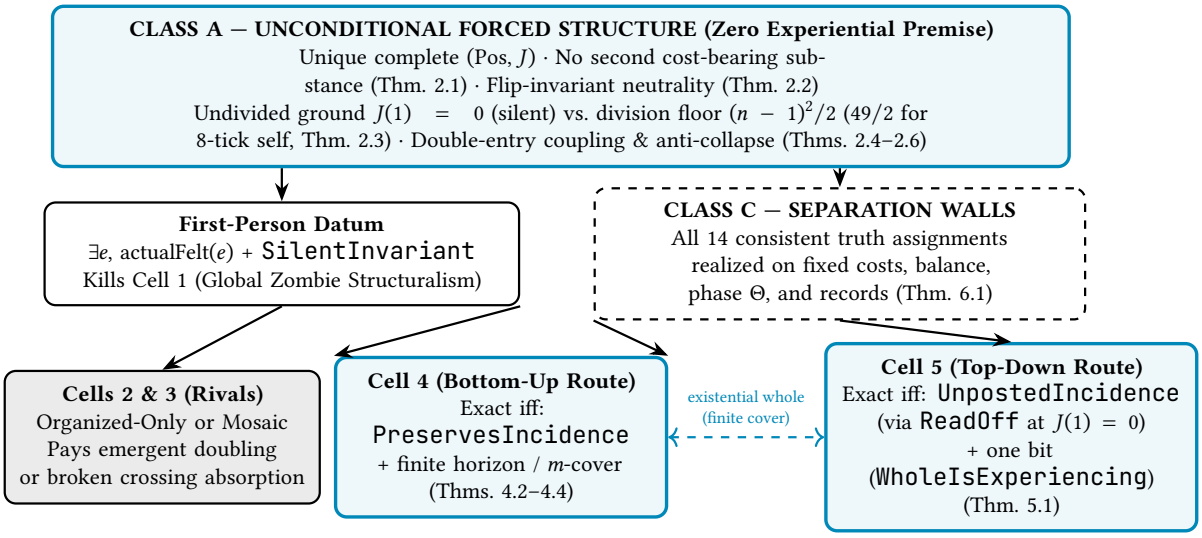


Figure 4. Unified Architecture Map of Universal Consciousness inside Recognition Science. Unconditional Class A theorems fix one cost-bearing substrate and the $(n-1)^2/2$ division cost asymmetry. Adding the minimal first-person datum refutes global erasure (Cell 1) and separates into either rivals that pay explicit structural discontinuities (Cells 2–3) or the two exact conditional reductions to nested universal consciousness: bottom-up crossing preservation (Cell 4) and top-down silence via `ReadOff` plus one bit at ratio 1 (Cell 5).

7 The Universal Consciousness Conjecture: What We Hold and Why

Having separated every proved theorem from every open seam with zero smuggling, we now state plainly on the record what the architecture leads us to conjecture as physical truth, why every converging line of evidence favors it over its rivals, and what exact mathematical and physical steps would settle it.

Conjecture 7.1 (The Universal Consciousness Conjecture)**.** *Physical reality as governed by the forced comparison structure* (Pos, J) *is* ***one nested experiencing whole*** *(uniting Cells 4 and 5):*

1. ***Experiential ground:*** *The unique zero-cost unposted totality ($x = 1$, $J(1) = 0$) is not merely a formal identity element, but the lit experiential ground of the ledger (the single top-down bit of Theorem 5.1 takes value* true*).*
2. ***Composition without radical emergence:*** *Differentiated felt intensity $e(x)$ on comparisons obeys the exact Recognition Composition Law* (2)*, ruling out arbitrary cost thresholds and dead zones near balance (Theorem 3.4) and grounding differential experience at every off-balance comparison, with $e(1) = 0$ recording zero differential strain at the silent ground rather than absence of ground presence (respecting* `graded_support_table_iff_zero`*).*
3. ***Nested decombination and crossing preservation:*** *Finite conscious beings arise as bounded, positive-cost cuts of the one experiencing whole—paying at least $49/2$ for every complete eight-tick reflexive boundary (Theorem 2.3)—and realized double-entry crossings preserve joint incidence within the encompassing whole (*`PreservesIncidence`*, Theorem 4.2) without collapsing distinct local histories, perspectives, or moral accountability (Theorem 2.6).*

7.1 Why the Forced Architecture Points Toward Conjecture 7.1

Although Conjecture 7.1 is not a pure deductive theorem of third-person cost algebra alone, four independent structural convergences make it the uniquely natural physical reading of the Single Shape:

1. **Zero room for a second cost-bearing substance.** Theorem 2.1 closes the door on interactionist dualism: no separate mental realm can carry lawful cost alongside (Pos, J). Retreating to a cost-silent epiphenomenal double makes our own verbal and physical reports of consciousness causally detached from experience itself. Once experience is placed inside the single forced comparison ledger where it belongs, the question becomes not *whether* the ledger carries feeling, but whether feeling obeys the same universal, scale-free logic as everything else on the ledger.

2. **Every organized-only rival invents a sharp discontinuity that the equation never contains.** Theorems 3.2–3.4 show that the comparison cost $J(x)$ is complete and scale-free, with no external knob setting a consciousness cutoff at neurons, bits, or mass. Any organized-only rival inside Recognition Science must break either `DoublingDescent` (declaring that doubling a strictly unfelt comparison suddenly ignites consciousness from zero) or orthogonal co-presence. By contrast, letting differentiated felt intensity obey the exact same composition law as J leaves zero dead zone near balance and removes every threshold automatically.

3. **The cost geometry of the ledger matches the phenomenology of universal mind and local self.** A major historical puzzle for cosmopsychism has always been: *if there is one universal consciousness, why does it not show up as one more noisy object inside physics, and why do we experience ourselves as separate finite selves?* Theorem 2.3 answers both halves directly from bare arithmetic. The undivided ground ($n = 1$) sits uniquely at $J(1) = 0$ and is therefore *necessarily observationally silent*—and by Cantor diagonalization, no posted finite observer can ever attain universal scope over all predicates on its domain. Conversely, carving a finite reflexive perspective that holds eight ticks against itself pays an irreducible self-reference price of at least $49/2$. Separateness is not a separate substance; it is the positive cost of maintaining a finite boundary opening on one silent whole.

4. **Moral and economic structure gains its living ground without erasing persons.** Theorem 2.6 proves two complementary facts: under double entry from a balanced baseline, every local harm registers as a strictly positive rise in the whole ledger's cost; yet collapsing local minds into an undifferentiated whole destroys consent, liability direction, and member-level decision recovery. Nested universal consciousness satisfies both demands simultaneously: local minds remain real, private, and accountable, while the encompassing whole holds every posted strain across the ledger—making the Golden Rule a literal symmetry of nested boundaries on one living reality rather than cold cosmic accounting.

7.2 Exact Open Program: What Would Turn the Conjecture into a Theorem

Conjecture 7.1 is falsifiable in structure and identifies three concrete targets for future derivation:

1. **Deriving the crossing or intensity bridge from native dynamics:** Show whether the physical dynamics of double-entry attachment (turning an open posting into a committed entry on the retained ledger) forces either `PreservesIncidence` across crossings or the composition law `ComposesFromParts` for experiential states, or prove a sharper dynamical barrier showing why no purely third-person dynamical law can fix the bit at ratio 1.
2. **Settling horizon persistence:** From the global conservation and finite-origin laws, derive either finite realized coverage (`RealizedRecordFiniteCost`) or a bounded anchor-domain cover (`AnchorDomainCover`, Theorem 4.4) so that persistence of one experiencing whole across growing ticks is decided rather than postulated.
3. **Empirical boundary tests:** Probe the concrete boundary between organized-only rivals (Cell 2) and universal composition (Cells 4–5) in complex coherence transitions, anesthetic decoupling of eight-tick boundary closures, and multi-boundary phase coupling—testing whether experiential transitions behave as sharp discontinuous onset jumps or continuous boundary-aperture modulations on one conserved ledger.

8 Formal Verification Summary

Every mathematical claim in Sections 2–6 corresponds directly to compiled, independently re-verified Lean 4.27 modules archived in the Recognition Science Institute `reality` formalization archive (commit prefix `ee235f70`, November 2026). Each module compiled with exit code 0 under `-DautoImplicit=false -DwarningAsError=true`, with zero `sorry`, zero `admit`, zero `native_decide`, zero custom axioms (strictly within `[propext,Classical.choice,Quot.sound]`), and zero flags under automated hypothesis-smuggling analysis. Table 2 records the exact audited inventory and SHA-256 hashes across all seven modules (537 primary roots plus 6 cross-module integration roots).

Table 2. Machine-Verified Lean 4.27 Module Inventory. All seven modules independently compiled with zero warnings, zero smuggling flags, and standard logical axioms only (`std3`).

Module	Roots	SHA-256 Prefix	Core Results Verified
`UniversalConsciousnessMaster`	34	`b98be1792c4e`	Balance recovery; finite-horizon two-wall iff; bounded m-anchor cover (arbitrary size); 14-model 5-Bool separation spectrum
`ForcedMonismBridge`	75	`e453a562486a`	Retraction & no proper lawful extension; no second cost-bearing substance; silent double; `RootClosed` kills 2-kind composing split
`Wall1UniversalFeeling`	151	`b413410a3832`	Doubling-descent trichotomy; discrete golden-ladder rung-1 descent; `ComposesFromParts` zero-dead-zone lattice; 8-tick & 4/64 rivals
`Wall2WholeRealization`	82	`cbc51c0393b4`	Balanced 3-posting 3-account triangle obstruction; finite-horizon limit collapse; arbitrary-size top-level/maximal-closed iff; nesting price of limit wall
`UnpostedWholeDecombination`	92	`afa2b1fb6f75`	Division floor $(n-1)^2/2$ and 8-tick 49/2; zero cost $\iff$ silence; silence-plus-one-bit iff; real-type dark/lit separation
`OperationalEthicalNecessity`	103	`ae8fb1936e5c`	Substrate neutrality as flip invariance; recurring-state no-commit vs. path holonomy; 4/64 closed sector; balanced-baseline harm & anti-collapse
`CrossLaneCheck`	6	`4637bb2effce`	Cross-module type alignment; unbalanced local-harm witness (`local_harm_can_rise_at_fixed_whole_cost`)
Total	**543**	**7 / 7 audited**	**0 sorry · 0 warnings · 0 custom axioms · 0 smuggling flags**

References

[1] J. Washburn, *The Single Shape of Reality: Derivation of Physical Law from One Symmetric Comparison Cost*, Version 2.0, Recognition Science Institute (2026), Zenodo `10.5281/zenodo.24590529`, Pith `10.67347/pith.preprint.2026.000101`.

[2] J. Washburn, *One Field, Many Boundaries: Path Holonomy, Quantized Records, and Recognition Boundaries*, Recognition Science Institute (2026).

[3] J. Washburn, *The Self Is Never Free: Self-Reference Cost and Cantor Non-Satiability on the Recognition Ledger*, Recognition Science Institute (2026).

[4] J. Washburn, *Four Seams of the Information Ledger: Commitment, Addressed Retrieval, Calorimetric Erasure, and Finite Origin*, Recognition Science Institute Formalization Archive (2026).

[5] J. Washburn, *Universal Consciousness Necessity Formalization Archive* (543 verified Lean 4.27 theorem roots across seven modules), Recognition Science Institute `reality` repository, commit `ee235f70` (2026).