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Substratism: The Material Continuity of Being

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Abstract

Substratism is a neurophilosophical framework in personal identity and consciousness studies. It addresses a category error common to discussions of consciousness and death: the conflation of the cessation of conscious organization with the termination of material existence. The framework maintains three strictly distinct categories. Being is the historically continuous material substrate that participated in the consciousness-enabling biological organization of the person. Entity is the autopoietic living organism. Identity is the arousal-enabled conscious organization instantiated upon that substrate during life. Death dissolves Identity and typically Entity, but does not annihilate Being. In this framework, postmortem material continuity refers only to the lawful persistence, dispersal, and possible biological re-entry of the historical material substrate that constituted a person. It does not refer to memory survival, soul survival, personality continuation, resurrection, reincarnation, religious afterlife, near-death experience, paranormal survival, or uninterrupted continuation of the current first-person stream of experience. Biogeochemical substrate re-entry names the possible later incorporation of such material into living systems. These are material-continuity terms, not religious or psychological-survival claims. Brainstem-thalamic arousal systems are treated as necessary enabling conditions for wakeful conscious presence, not as sufficient generators of full human identity. The locus coeruleus is a candidate low-turnover marker within a distributed ascending arousal system, not the seat of selfhood or consciousness. If a different consciousness-enabling tissue better satisfies the retention and functional criteria, the candidate substrate must be relocated and the locus-coeruleus-specific version of the hypothesis is treated as falsified. The article proposes a staged research program of experimental protocols, to be preregistered before any future data collection, designed to test atom retention in candidate macromolecules, arousal-system dependence in disorders of consciousness, and biogeochemical substrate re-entry of historical material substrate. No new data are reported. The contribution is to make material-token continuity philosophically explicit, distinguish it from psychological, narrative, organismal, and pattern-copy accounts of personal identity, and specify the empirical conditions under which substrate continuity within consciousness-enabling biology can be tested or constrained.

Key Words: Substratism, personal identity, consciousness, material continuity, neurophilosophy

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Introduction

Personal-identity theory has long oscillated between psychological-continuity accounts grounded in memory and narrative (Locke, 1689/1975; Parfit, 1984; Schechtman, 1996) and animalist accounts that ground persistence in organismal life (Olson, 1997). In parallel, consciousness studies has distinguished conscious level or state from conscious content and has converged on the importance of brainstem-thalamic arousal architecture for sustained wakeful access (Dehaene and Changeux, 2011; Koch et al., 2016; Aston-Jones and Cohen, 2005; Schiff et al., 2007; Edlow et al., 2012; Edlow et al., 2024). Molecular turnover biology has separately shown that some neuronal populations are developmentally long-lived (Spalding et al., 2005), that nuclear-pore scaffolds and other long-lived proteins exhibit exceptional stability rather than ordinary rapid turnover (Toyama et al., 2013), and that locus coeruleus neurons contain neuromelanin-related material markers relevant to low-turnover substrate analysis without functioning as simple lifelong population-level archives (Zucca et al., 2017; Riley et al., 2025). These literatures are rarely integrated.

The integrative gap is the absence of a framework that takes seriously what would follow if the historical material substrate of consciousness-enabling biology were treated as identity-relevant in a sense distinct from memory, narrative, organismal life, or pattern-copy identity. Substratism articulates that framework. It maintains three strictly distinct categories — Being (the historically continuous material substrate that participated in the consciousness-enabling biological organization of the person), Entity (the autopoietic living organism), and Identity (the arousal-enabled conscious organization instantiated upon that substrate during life) — and argues that the deepest same-one continuity of an individual, where any such continuity obtains, is grounded in material-token continuity within consciousness-enabling biology. The article uses postmortem material continuity as a bounded technical term denoting only the lawful persistence, dispersal, and possible biological re-entry of that historical substrate. It does not denote soul-survival, memory-survival, personality continuation, resurrection, reincarnation, religious afterlife, or uninterrupted continuation of the current first-person stream of experience. Death dissolves Identity and often Entity, but not Being.

The article's contribution is to join personal-identity philosophy, consciousness-enabling neurobiology, and molecular turnover biology. It specifies a five-level claim hierarchy that separates empirical claims from philosophical commitments. It also identifies the locus coeruleus as one candidate substrate for empirical scrutiny while foregrounding that the relevant arousal architecture is distributed rather than LC-exclusive. The Materials and Methods

section sets out the methodological posture, the claim hierarchy, and a staged research program. The Results and Discussion section develops the framework, situates it relative to existing theories, presents candidate substrates, sets the philosophy-of-science boundary, addresses six core objections, and identifies the conditions under which the framework would be weakened.

Materials and Methods

Methodological Approach

This article combines conceptual analysis, inference to the best explanation, and empirical constraint mapping. Conceptual analysis distinguishes Being, Entity, and Identity. Inference to the best explanation compares Substratism against psychological, organismal, informational, and biological accounts of continuity. Empirical constraint mapping identifies where neuroscience, molecular turnover biology, and isotope tracing can test or limit the framework. The aim is not to establish personal survival experimentally, but to identify whether a material-continuity condition has been underexamined in theories of personal identity and consciousness.

Claim Hierarchy

The framework's claims are graded across five levels, kept separate so that evidence supporting any lower level cannot be treated as automatic confirmation of a higher level.

Level 1 — Conservation premise. The atoms that composed a person persist after death and disperse through ordinary biogeochemical cycling.

Level 2 — Biological-substrate premise. Certain postmitotic neurons and macromolecular assemblies exhibit extremely low molecular turnover; some components can be as old as the individual, while neuromelanin-related LC markers must be treated cautiously because LC signal and neuronal integrity can vary across aging and neurodegeneration (Spalding et al., 2005; Toyama et al., 2013; Zucca et al., 2017; Riley et al., 2025).

Level 3 — Operational claim. The historical personal substrate can in principle be traced using retrospective isotope-tracing logic, accelerator mass spectrometry, nanoSIMS, and mass-balance methods, subject to specified detection thresholds and controls. With current technology, these methods are best treated as postmortem or ex vivo approaches rather than in vivo atom-tracking methods in living human consciousness-enabling neurons.

Level 4 — Neurobiological hypothesis (the locus-coeruleus-specific Being-Core Hypothesis, BCH). A low-turnover, continuity-bearing

candidate substrate may exist within consciousness-enabling brainstem-thalamic arousal systems. The locus coeruleus is treated as a candidate marker within a distributed ascending reticular activating system (ARAS), not as the sole anatomical seat of arousal, selfhood, or consciousness (Edlow et al., 2012; Aston-Jones and Cohen, 2005). This level is falsifiable.

Level 5 — Philosophical identity thesis. If such a substrate is continuity-bearing, then same-one continuity is deeper than memory continuity, narrative continuity, organismal life, or abstract pattern-copy identity. This is a philosophical thesis informed by, but not reducible to, evidence at Levels 1–4. A failure at Level 4 falsifies the LC-specific BCH but leaves the broader framework available only by relocation to a tissue that better satisfies the same retention and functional criteria under the same standards.

Epistemic bridge principle

Evidence at Levels 1-4 constrains Level 5 only when the same candidate substrate satisfies three conditions: material retention, consciousness-enabling functional relevance, and operational traceability. If a candidate arousal-system substrate showed unusually high material retention and reliable dependence relations with validated measures of conscious state or complexity, then the Level-5 thesis would become a more plausible interpretation of continuity. It would not be logically forced. Conversely, if no consciousness-enabling substrate satisfies retention, functional relevance, and traceability together, then the Level-5 interpretation loses empirical traction even if ordinary material conservation remains true.

Proposed Research Program

The proposed research program is staged rather than presented as a completed experiment. M1 examines disorders-of-consciousness cases to test whether arousal-system integrity corresponds to behavioral responsiveness and brain-complexity measures, drawing on PCI/PCI-ST and CRS-R logic (Casarotto et al., 2016; Comolatti et al., 2019; Schiff et al., 2007; Edlow et al., 2012). M2 compares the locus coeruleus with alternative arousal nodes such as the paraventricular thalamus and basal forebrain (Ren et al., 2018; Aston-Jones and Cohen, 2005). M3 tests projection-specific arousal pathways, especially LC–thalamic interactions. M4 is retained only as an exploratory developmental-timing extension. M5 uses isotope-tracing logic to model postmortem material continuity and possible biogeochemical re-entry (Spalding et al., 2005; Toyama et al., 2013). Across all protocols, thresholds, stimulation parameters, imaging proxies, and statistical models are working specifications to be

finalized before future data collection. Positive results would support or constrain Levels 1–4; they would not prove psychological survival or settle the Level-5 philosophical thesis. The bridge between arousal-system testing and atom-retention testing requires convergence rather than simple association. Arousal-system integrity alone would not establish material-token continuity, and isotope tracing alone would not establish consciousness-enabling relevance. A candidate substrate becomes relevant to Substratism only if it shows low turnover or historical material retention, functional implication in arousal-enabled conscious organization, and traceability by postmortem or ex vivo methods. M1-M3 therefore test functional relevance, whereas M5 tests material continuity. The framework gains empirical force only where these lines of evidence converge on the same candidate substrate or substrate class. The conceptual map summarizing the framework and the proposed protocols is shown in Figure 1.

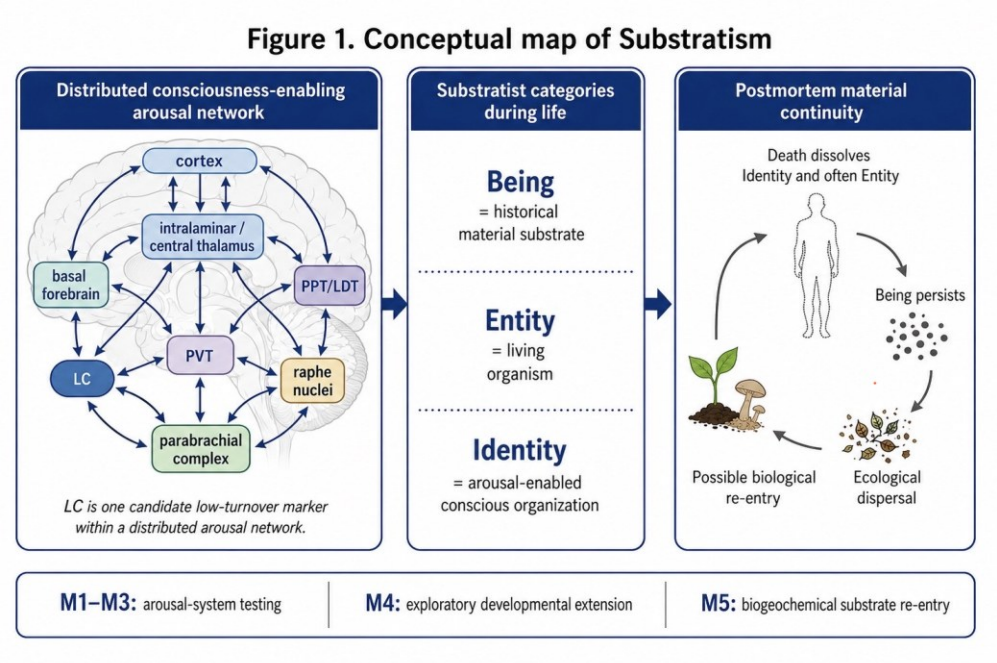

Figure 1. Conceptual map of Substratism. The figure relates a distributed consciousness-enabling arousal network to the three Substratist categories: Being, Entity, and Identity. The locus coeruleus is presented as one candidate low-turnover marker within a broader arousal-related network that includes thalamic, basal forebrain, raphe, parabrachial, tegmental, and cortical nodes. M1-M3 indicate arousal-system testing, M4 indicates exploratory developmental extension, and M5 indicates biogeochemical substrate re-entry testing.

Results and Discussion

No new experimental data are reported. The material that follows presents theoretical predictions, expected outcomes, and proposed

falsification criteria. The philosophical thesis (Level 5) is held distinct from the evidence-bearing claims (Levels 1–4).

Being, Entity, and Identity

Substratism argues that the deepest continuity of the same individual, where any such continuity obtains, is grounded not primarily in memory, narrative, personality, organismal life, or abstract informational pattern, but in a historically continuous material substrate that once participated in the consciousness-enabling biological organization of that individual. The framework rests on three strictly distinct categories: Being, Entity, and Identity. It asserts no immaterial residue, no surviving subjectivity, no preserved memory, and no continued personhood after death. The central categories are summarized in Table 1.

Table 1. *Category distinctions among Being, Entity, and Identity.*

Category	Definition	What ends at death?	What persists?	Candidate testable marker
Being	Historically continuous material substrate that participated in the consciousness-enabling biological organization of the person	Does not end; matter is conserved	Material substrate persists and disperses through biogeochemical cycling	Atom-retention assays; isotopic mass-balance closure
Entity	Autopoietic living organism; self-maintaining biological unity holding the substrate together during life	Typically ends at biological death; organismal integration collapses	No organismal unity; tissues dissociate	Clinical/functional markers of organismal viability; criteria for biological death
Identity	Arousal-enabled conscious organization instantiated upon the substrate during life	Ends at the loss of the arousal-enabled organization	No psychological continuity; no memory, narrative, or perspectival continuation	PCI/PCI-ST; behavioural responsiveness (CRS-R); composite arousal-system indices

Two states of affairs that share the same Being need not, and typically do not, share the same Identity. If a portion of a person's material substrate is incorporated into a new organized living system, a new Identity may arise on that substrate, numerically distinct from the prior Identity, sharing no memory, narrative, perspective, or subjective

continuity with it. Substratism claims that Being persists; it does not claim that Identity persists, returns, or recurs. Substratism does not claim that the previous subject, memory, or the old perspective continues; it claims that the historical material substrate may become experience-bearing again only if reorganized with a new consciousness–enabling biological system.

Death, Oblivion, and Postmortem Material Continuity

Strong versions of the "eternal oblivion" thesis hold that death is the total annihilation of the person. Substratism rejects only one part of this thesis: the part that treats loss of consciousness as loss of material Being. The framework agrees that death dissolves Identity and typically dissolves Entity, but denies that it annihilates Being.

This denial is not a claim of survival in any psychological, religious, or supernatural sense. It does not assert that memory, personality, soul, ego, resurrection, reincarnation, or uninterrupted conscious experience persist across the moment of biological death. It asserts that the matter that participated in the person's conscious life persists lawfully and may, through ordinary biogeochemical processes, re-enter biological systems elsewhere.

The framework's central statement: *Death dissolves Identity and often Entity, but not Being; Being persists as conserved historical material substrate and may lawfully re-enter life through ecological cycling.*

Postmortem material continuity is the bounded Substratist term for the lawful persistence, dispersal, and possible biological re-entry of the historical material substrate that constituted a person. Biogeochemical substrate re-entry names the ecological process by which such material may later be incorporated into living systems. The empirical side of this claim concerns material continuity; its identity-significance remains a philosophical thesis constrained by, but not reducible to, empirical evidence.

What This Theory Does Not Claim

The framework does not claim that memory, personality, autobiographical narrative, or consciousness survives death. It does not claim the existence or persistence of a soul. It does not claim that reincarnation, resurrection, or any religious survival doctrine is empirically supported. It does not claim that isotope tracing supports personal psychological survival. It does not claim that the locus coeruleus is the seat of selfhood or consciousness. It does not claim to explain why arousal-enabled organization is accompanied by phenomenal experience. It asks whether a continuity-bearing material substrate within consciousness-enabling biology could ground a stricter notion of same-one continuity than psychological, organismal,

or informational accounts can supply, and proposes how that question can be empirically constrained.

Theoretical Positioning

Substratism is in tension with the major personal-identity programmes. Locke (1689/1975) and the broad psychological-continuity tradition that Parfit (1984) and Schechtman (1996) extended ground the same person in psychological connections among mental states; Substratism does not endorse those psychological connections as the deepest layer of same-one continuity. Animalism (Olson, 1997) grounds persistence in organismal life; on Substratism, organismal life is the Entity layer, distinct from the substrate-token continuity of Being and from arousal-enabled Identity. The framework is incompatible with strict pattern-copy criteria of identity: a perfect functional copy with no shared historical substrate would, on Substratism, instantiate a different Being even if the resulting Identity were qualitatively indistinguishable.

This point also clarifies the framework's relation to Parfit's "what matters" analysis. Substratism does not deny that psychological continuity, memory, character, and experiential connectedness matter at the level of Identity. It denies only that those relations exhaust all forms of continuity. A perfect functional copy may preserve type-pattern similarity and qualitative indistinguishability, but it does not preserve the same historical material substrate. Therefore, on Substratism, it may preserve what matters for psychological reconstruction while failing to preserve what matters for Being-level continuity. Many objections define the "I" too high in the structure, at the level of personality, memory, organismal life, or current first-person perspective. Substratism asks whether the deeper material basis that made personhood and experience possible also deserves identity-significance. In this sense, the central question shifts from "Will my personality continue?" to "What am I beneath personality, memory, organism, and current perspective?"

Recent work on the ascending reticular activating system strengthens the need to distinguish memory-based psychological continuity from arousal-enabled conscious presence. Meier argues that damage to the ARAS could permanently abolish wakefulness while leaving the neural correlates of standing mental states, including memory-related structures, outside the primary damaged region (Meier, 2023). This creates pressure on Lockean accounts that identify persistence too closely with memory continuity. Substratism accepts this pressure but extends it in a different direction: it treats arousal-enabling biology not merely as a problem for psychological continuity, but as one possible site where historically continuous material substrate may become philosophically relevant.

In consciousness studies, the framework engages but does not attempt to settle major theories of conscious content, integration, or neural correlates. Global Neuronal Workspace theory and neural-correlate approaches help distinguish conscious level, conscious content, and reportable access (Dehaene and Changeux, 2011; Koch et al., 2016). Substratism remains compatible with such approaches so long as the substrate carrying the relevant dynamics is treated as historically continuous. The framework does not explain why arousal-enabled organization is accompanied by phenomenal experience. Its claim is narrower: where such organization exists, the same-one question of personal continuity is best framed by the substrate that supports it.

Candidate Neurobiological Substrates

The locus coeruleus is a candidate target because of its noradrenergic projections, arousal relevance, postmitotic neuronal status, and neuromelanin-related material stability in surviving catecholaminergic neurons (Aston-Jones and Cohen, 2005; Zucca et al., 2017; Riley et al., 2025). However, the framework does not privilege the LC as the seat of selfhood, consciousness, or personal identity. The ascending arousal system is distributed and includes the paraventricular thalamus, basal forebrain cholinergic systems, raphe nuclei, parabrachial complex, pedunculopontine and laterodorsal tegmental nuclei, intralaminar or central thalamic nuclei, and related brainstem-thalamic-cortical pathways (Edlow et al., 2012; Ren et al., 2018; Edlow et al., 2024). LC is therefore best treated as one candidate low-turnover marker within a broader consciousness-enabling arousal network. If another node or tissue class better satisfies material retention, functional relevance, and traceability, the candidate substrate must shift.

The framework's candidate substrate must satisfy three criteria: material historical continuity in the conservation-and-low-turnover sense; functional implication in consciousness-enabling organization; and traceability by the methods specified at Level 3. Generic body matter satisfies the first but not the second. Consciousness-enabling matter is privileged only because it is the candidate substrate most directly connected to the emergence of subject-bearing organization.

Candidate substrates range from postmitotic neuronal populations to slow-turnover scaffolds and functional macromolecules in wakefulness-related nuclei (Spalding et al., 2005; Toyama et al., 2013). Neuromelanin in surviving LC neurons remains a possible material marker, but it should not be treated as a simple lifelong population-level archive, because LC signal and neuronal integrity may change in late life and neurodegeneration (Zucca et al., 2017; Riley et al., 2025). Direct human atom-retention data for living consciousness-enabling neurons remain unavailable.

Philosophy-of-Science and Epistemic Boundary

The empirical tests proposed here examine material continuity, not psychological survival. Substrate continuity at the cellular, scaffold, or molecular level is testable in principle through isotope-tracing logic and validated complexity-and-arousal proxies; the philosophical claim that such continuity grounds the deepest sense of same one — the Level-5 thesis — is constrained but not entailed by any positive empirical finding at Levels 1–4. The framework treats carbon and nitrogen as practical tracing targets because of biological abundance and assay accessibility, not because they are uniquely identity-bearing; the same material-continuity logic applies in principle to any tracer that tracks atoms through wakefulness-related biology (No Privileged Carbon). The framework is empirically constrained and philosophically committed. Empirical refutation at Levels 1-4 would weaken Level 5; empirical confirmation at Levels 1-4 would not settle Level 5, which remains a metaphysical thesis. The constraint is evidential, not deductive. Positive findings at Levels 1-4 would not entail Level 5, because no finite empirical result can logically force a metaphysical interpretation of same-one continuity. However, convergent evidence for material retention, arousal-system dependence, and traceability in the same candidate substrate would make a substrate-continuity interpretation more empirically disciplined than a purely speculative version of the claim. Negative findings would not refute ordinary conservation of matter, but they would weaken Substratism as a theory of consciousness-relevant material continuity.

Objections and Boundary Conditions

Six objections are anticipated. The One-Atom Problem: identity cannot turn on a single atom; the framework concedes this and treats Being as a population-level historical-substrate property admitting of degree. The Dilution Problem: matter disperses to many recipients after death; the framework concedes biogeochemical dispersal and treats biological re-entry as numerical, not personal, identity-bearing — same Being is not same Identity. The Copy / Teleporter Problem: a perfect functional copy with no shared historical substrate would, on Substratism, instantiate a different Being even if the copy's Identity were qualitatively indistinguishable. This does not deny Parfit's claim that psychological continuity may be what matters for many practical, ethical, or prudential purposes. It denies that psychological continuity exhausts all continuity relations. Pattern-copying may preserve Identity-like organization while failing to preserve Being-level material-token continuity. The LC-overcommitment objection: the locus coeruleus is not the seat of selfhood or consciousness; it is named only as one candidate substrate within a distributed arousal-enabling network, and the framework relocates if alternative arousal nodes better satisfy material retention, functional relevance, and traceability.

The REM / LC-OFF objection is important because phenomenal experience continues during dreaming even when LC activity is strongly reduced (Aston-Jones and Bloom, 1981; Hayat et al., 2020). This weakens any LC-exclusive account of consciousness. Substratism therefore does not treat LC activity as a necessary moment-by-moment generator of experience. LC is treated only as one candidate material marker within a distributed arousal-enabling system. REM sleep weakens LC exclusivity, not the broader claim that historically continuous substrate within consciousness-enabling biology may be philosophically relevant. The Arousal vs. Consciousness objection: arousal is not the whole of consciousness; the framework explicitly treats arousal as an enabling condition, not a sufficient one for conscious content, reportable access, or full personal identity (Dehaene and Changeux, 2011; Koch et al., 2016).

Limitations and What Would Weaken the Theory

Several findings would weaken the framework. (i) If precise functional duplicates with no shared historical substrate proved to instantiate the same person under every defensible criterion of personal identity, the substrate-token premise of Being would fail. (ii) If atom-retention data showed that wakefulness-related neuronal substrates undergo total atomic turnover on a timescale shorter than diachronic Identity, the candidate-substrate thesis at Level 2 would fail. (iii) If complexity-and-arousal measures dissociated entirely from any candidate substrate across disorders of consciousness, the Level-3 functional linkage would fail. (iv) If projection-specific manipulation of LC-thalamic pathways had no effect on arousal-driven complexity measures, the LC-specific corollary would be falsified, though the framework would relocate only if another candidate substrate satisfied material retention, functional relevance, and traceability together. The framework is limited by the current unavailability of direct human in vivo atom-retention data, by the early state of validated complexity proxies in non-research clinical settings, and by the fact that Level 5 is a philosophical thesis not settled by any finite empirical evidence; it does not explain why arousal-enabled organization is accompanied by phenomenal experience, does not entail psychological survival, and does not specify a translational protocol.

Abbreviations

AMS, accelerator mass spectrometry; ARAS, ascending reticular activating system; BCH, Being-Core Hypothesis; CRS-R, Coma Recovery Scale–Revised; LC, locus coeruleus; PCI-ST, perturbational complexity index-state transition; REM, rapid eye movement.

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