Cross-Domain Convergence on a Coherence Equation: Aperiodic Substrate, Periodic Modulation, and the Critical Zone Across Eight Evidence Domains

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Abstract

A recurring decomposition — aperiodic substrate + periodic modulation → coherence — appears independently across eight research domains: neural dynamics, cardiovascular physiology, therapeutic process, archaeoacoustics, physical systems, contemplative practice, near-death studies, and psychedelic neuroscience. This paper presents the cross-domain convergence across 190+ peer-reviewed papers, a vocabulary analysis (Modulation Dominance Index) showing modulation language outweighs generation language by 3.9:1 to 6.6:1 in researchers' own abstracts, and a longitudinal self-mapping study (N=1, 24,700+ timestamped data points, 10 classified states) in which the equation was identified from direct experience before the supporting literature was found. A regime shift at the dataset's transition point ($r = +0.035 \rightarrow r = -0.294$, $p = 3.08 \times 10^{-11}$) demonstrates measurable change in structural dynamics. Multiple frameworks from biology, computation, and physics identify optimal function in an intermediate regime between order and disorder. The findings are consistent with a tuning model of consciousness and less easily reconciled with strict neural generation models. All data and methods are open source.

Keywords: consciousness, coherence, aperiodic, periodic, self-organized criticality, filter hypothesis, cross-domain convergence, near-death experience, psychedelics, contemplative neuroscience

1. Introduction

Consciousness research is fragmented. Neuroscientists study neural correlates. Physicists model quantum coherence. Therapists observe transformation processes. Archaeologists measure resonant chambers. Contemplative traditions map interior states. Near-death researchers document anomalous experiences. Psychedelic scientists track what happens when neurochemical filters shift. Each domain generates findings. Few connect them.

This paper connects them.

A single structural pattern appears across all eight domains: an aperiodic (scale-free, non-repeating) substrate, modulated by periodic (rhythmic, repeating) input, produces coherence (organized, integrated states). The decomposition is literal in several domains — brain EEG and cardiovascular physiology use this separation as standard methodology — and the paper provides operational mappings for each (Section 1.1):

- Neural EEG decomposes into aperiodic 1/f background + periodic oscillatory peaks (Donoghue et al. 2020)
- Heart rate is fractal variability modulated by respiratory rhythm (Bernardi et al. 2001; Porges 2011)
- Therapeutic change follows aperiodic activation structured by periodic mismatch protocols (Ecker et al. 2012; Nader et al. 2000)
- Ancient chambers filter broadband (aperiodic) vocal excitation through resonant (periodic) architecture at 95–120 Hz (Jahn et al. 1996; Reznikoff & Dauvois 1988)
- Physical systems at criticality balance scale-free fluctuations with periodic driving (Bak 1996; Beggs & Plenz 2003)
- Contemplative practices apply periodic structure (breath, mantra, rhythm) to the aperiodic default mode (Lutz et al. 2004; Brewer et al. 2011)
- Near-death experiences occur when the brain's filtering capacity is compromised (van Lommel et al. 2001; Parnia et al. 2023)
- Psychedelics reduce brain activity while expanding measurable consciousness (Carhart-Harris et al. 2012; Schartner et al. 2017)

Multiple frameworks identify optimal function in an intermediate regime between order and disorder. Kleiber's metabolic scaling law (West et al. 1997), Bak's self-organized criticality (1996), Tononi's integrated information theory (2004), Friston's free energy principle (2010), Kelso's metastability (1995), Watts-Strogatz small-world networks (1998), and Langton's edge-of-chaos lambda parameter (1990) all describe systems that function best near a critical boundary — not at maximal order and not at maximal entropy. The specific parameterizations differ across frameworks and are not directly commensurate (Section 5.2 addresses this). The structural claim is that an intermediate optimum exists across these systems; the N=1 dataset identifies a specific regime (Section 3) that may or may not map formally onto these frameworks.

The equation:

> **ψ = aperiodic substrate + periodic modulation → coherence**

was not derived from this literature. It emerged from a longitudinal self-mapping study — 24,700+ timestamped experiential data points, classified into 10 functional states with defined transition rules — before any of the supporting literature was found. The timeline is documented in Section 3. The literature was discovered afterward, domain by domain, and each domain confirmed the same structure the mapping had already identified.

A Modulation Dominance Index (MDI) applied to the knowledge graph connecting these papers quantifies a striking vocabulary asymmetry: the language of tuning (coupling, entrainment, resonance, synchronization) dominates the language of generation (creates, produces, generates) by ratios between 3.9:1 and 6.6:1. This measures mechanistic vocabulary preference — what researchers reach for when describing how these systems work.

This paper presents definitions and operationalizations (Section 1.1), the convergence domain by domain (Section 2), the independent pathway through which the equation was identified (Section 3), the language measurement (Section 4), the implications (Section 5), and the limitations (Section 6).

1.1 Definitions and Operationalizations

The equation uses three terms that require domain-specific operationalization:

Aperiodic substrate. The scale-free, non-repeating component of a system's dynamics. Operationalized as: 1/f spectral exponent in neural EEG (Donoghue et al. 2020); fractal heart rate variability in cardiovascular physiology (Goldberger et al. 2002); broadband acoustic excitation in archaeoacoustics (Jahn et al. 1996); scale-free fluctuations in physical criticality (Bak 1996); default mode network activity in contemplative neuroscience (Brewer et al. 2011); disequilibrium/activated state in therapeutic process (Ecker et al. 2012).

Periodic modulation. A rhythmic, structured input that couples to the aperiodic substrate. Operationalized as: oscillatory peaks (alpha, theta, gamma) in neural dynamics; respiratory rhythm (~6 breaths/min at cardiovascular resonance) in physiology; architectural resonance at 95–120 Hz in archaeoacoustics; mantra, breath, drumming in contemplative practice; structured mismatch protocols in therapy; pharmacological perturbation of filter dynamics in psychedelic neuroscience.

Coherence. An increase in measurable order, integration, or structured dynamics relative to baseline. This term is deliberately broad because the claim is structural: the same three-

component decomposition appears across domains. The domain-specific metrics differ:

Domain	Coherence metric
Neural	Phase-locking value; spectral peak SNR; Lempel-Ziv complexity
Physiological	HRV coherence ratio; respiratory sinus arrhythmia amplitude
Therapeutic	Symptom resolution via reconsolidation; scale-based outcome measures
Archaeological	Measured acoustic resonance; documented perceptual effects
Physical	Order parameter at criticality; network modularity
Contemplative	Gamma synchrony; DMN deactivation; M-Scale scores
Near-death	Structured experience during cortical inactivity (NDE Scale)
Psychedelic	Above-waking Lempel-Ziv complexity; global brain integration

On metric non-equivalence. Phase-locking value and HRV coherence ratio are not the same construct. Lempel-Ziv complexity and M-Scale scores measure different things at different scales. This paper does not claim metric equivalence across domains. It claims a shared *decomposition structure* — that each domain separates into aperiodic and periodic components whose interaction produces a domain-specific order parameter — and a shared *response-to-modulation dynamic*. The metrics differ because the domains differ. The structural pattern recurs because (this paper argues) the underlying dynamic is the same.

The arrow (→). Throughout this paper, → denotes a dynamical transformation: when periodic modulation couples to an aperiodic substrate, measurable coherence (as operationalized per domain) increases relative to baseline. This is a claim about dynamics — not creation ex nihilo. The arrow is generative in the sense that a standing wave is generated when a medium meets resonant driving: the medium was always present; the organized pattern is new, measurable, and produced by the interaction.

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2. Results: The Equation Across Eight Domains

For each domain: what constitutes the aperiodic substrate, what constitutes the periodic modulation, and what coherence emerges. Domain-specific operationalizations are defined in Section 1.1.

2.1 Neural

Donoghue et al. (2020) demonstrated that brain EEG decomposes into an aperiodic (1/f) background and periodic oscillatory peaks. The FOOOF algorithm (900+ citations) is now standard in computational neuroscience. The equation is literally how the brain's electrical activity is structured.

Friston's Free Energy Principle (2006, 2010) describes self-organizing systems that minimize surprise through predictive modeling. Carhart-Harris & Friston's REBUS model (2019) extends this: psychedelics relax top-down priors, loosening the brain's filtering. Experience intensifies when the filter loosens — it does not diminish.

The brain operates at criticality (Kitzbichler et al. 2009; Beggs & Plenz 2003). Neural systems process information better with optimal noise than without (Ward 2010, stochastic resonance). The aperiodic substrate is functionally necessary.

Decomposition. Aperiodic: 1/f neural background. Periodic: oscillatory peaks (alpha, theta, gamma). Coherence: integrated brain states at criticality.

2.2 Physiological

The vagus nerve connects brainstem to gut, touching heart, lungs, and digestive system. Porges' polyvagal theory (2011) maps its operation through distinct circuits. Heart rate variability (HRV) is the direct readout of vagal flexibility.

Breath is the one autonomic function under voluntary control. Inhalation activates the sympathetic system; exhalation activates the parasympathetic via the vagus. Slow breathing at approximately 6 breaths per minute maximizes respiratory sinus arrhythmia — the coupling between breath and heart.

Bernardi et al. (2001) showed that Catholic rosary prayer and Hindu/Buddhist mantras — traditions from different continents, different millennia — both slow respiration to approximately 6 breaths per minute, the cardiovascular resonance frequency. The structure of the recitation drives the rate, not conscious intention.

Decomposition. Aperiodic: autonomic variability. Periodic: respiratory rhythm. Coherence: cardiovascular resonance.

2.3 Therapeutic

Every effective therapeutic modality follows four steps:

1. **Safety** — establish regulation

2. **Activation** — surface the material
3. **Mismatch** — introduce prediction error
4. **Integration** — the system rewrites the prediction

This is memory reconsolidation. Nader et al. (2000) proved memories become labile on retrieval. Ecker, Ticic & Hulley (2012) showed all effective psychotherapies work through this mechanism regardless of theoretical orientation.

IFS, coherence therapy, EMDR, psychedelic-assisted therapy, expressive writing (Pennebaker 1997), shamanic healing across 47 societies (Winkelman 2010), espiritismo and Candomblé (Koss-Chioino 2006) — different cosmologies, same four-phase structure. MAPS' MDMA-assisted therapy (Mitchell et al. 2021): 67% of severe PTSD patients no longer met diagnostic criteria after three sessions.

Decomposition. Aperiodic: disequilibrium/activation. Periodic: structured mismatch protocol. Coherence: updated prediction (reconsolidated memory).

2.4 Archaeological

The Hypogeum of Ħal-Saflieni in Malta (3400–2500 BCE) resonates at 110 Hz. Preliminary research (Cook et al. 2008) suggests this frequency range may shift brain activity toward right-hemisphere and prefrontal activation.

Göbekli Tepe (9500 BCE) was built before agriculture, before pottery — the impulse to create resonant ceremonial space preceded every other organizing principle of human culture.

Chavín de Huantar (1200–500 BCE): Stanford-led archaeoacoustic research (Kolar 2017) with IRB-approved human experiments demonstrated that the underground gallery system, with its twenty Strombus shell trumpets, creates systematic perceptual disorientation.

Paleolithic cave art predates all of it. Reznikoff & Dauvois (1988) showed 80–90% of art in French caves is placed at points of maximum acoustic resonance. Fazenda et al. (2017) independently replicated this in Spanish caves.

Six megalithic structures across the UK and Ireland all resonate between 95–120 Hz (Jahn et al. 1996). Different geology, different builders, different millennia — same frequency band, corresponding to low male chanting voice. The architecture amplifies the human body (Debertolis 2015).

Decomposition. Aperiodic: broadband vocal excitation. Periodic: chamber resonance filtering at 95–120 Hz. Coherence: altered perceptual states.

2.5 Physical

Non-locality is experimentally confirmed (Aspect 1982; every Bell test since). The measurement problem in quantum theory remains unresolved; some interpretations elevate the role of observation, but this paper does not depend on any particular quantum interpretation.

Seven independent frameworks identify optimal function in an intermediate regime between order and disorder:

Framework	Domain	Critical Parameter
Langton's λ	Computation	Edge of chaos
Bak's SOC	Physics	Power-law criticality
Tononi's Φ	Information	Integrated information maximum
Friston's FEP	Biology	Free energy minimum
Kelso's Metastability	Coordination	Dynamic stability
Watts-Strogatz	Network theory	Small-world threshold
Kleiber's Law	Biology	3/4 power scaling across 27 orders of magnitude

Self-organizing systems produce geometric order through optimization under constraint. Phyllotactic patterns in plants converge on golden-ratio spacing as an optimal packing configuration (Douady & Couder 1992). Fractal branching in biological transport networks minimizes energy dissipation (West, Brown & Enquist 1997). Dumitrescu et al. (2022): a Fibonacci-based quasiperiodic pulse protocol extended edge-qubit coherence from ~1.5s to ~5.5s relative to periodic driving in a trapped-ion system — demonstrating that modulation structure (not just modulation presence) affects coherence duration.

Decomposition. Aperiodic: noise/fluctuations. Periodic: driving signal. Coherence: critical state at the edge of chaos.

2.6 Contemplative

Every culture that has practiced sustained attention has arrived at the same map.

Same neural signature. Lutz et al. (2004): 25-fold gamma increase in experienced practitioners. Fox et al. (2014, meta-analysis): same 8 brain regions altered across all traditions. Brewer et al. (2011): default mode network deactivation across meditation types.

Same experience. Hood's Mysticism Scale (validated 25+ years): identical factor structure across Buddhist, Hindu, Muslim, Christian, and secular populations. Constructivism — the claim that culture shapes the experience itself — is empirically unsupported by Hood's data. Culture shapes interpretation, not structure.

Same destination. Psilocybin produces "complete mystical experience" in 61–72% under controlled conditions (Griffiths 2006, 2011), matching contemplative reports on the same validated scales. Brown (2006) found an invariant sequence across Mahamudra, Carmelite, and Theravada traditions. Ego dissolution predicts mystical experience at $\rho = 0.735$ (Nour et al. 2016).

Same technologies worldwide. Vaitl et al. (2005): convergent neurophysiology across meditation, hypnosis, sensory deprivation, fasting, drumming, and psychedelics. Neher (1961): traditional drumming frequencies fall in the theta range that entrains the brain. The traditions reverse-engineered the same nervous system independently.

Decomposition. Aperiodic: ordinary mind (default mode activity). Periodic: practice (breath, mantra, rhythm, devotion). Coherence: the state every tradition converges on.

2.7 Near-Death

Four prospective studies of experiences during cardiac arrest:

Study	Year	Journal	N (interviewed)	Any recalled experience	NDE per scale threshold
van Lommel et al.	2001	*The Lancet*	344	18%	12%
Greyson	2003	*General Hospital Psychiatry*	1,595	10%	10%
Parnia et al. (AWARE I)	2014	*Resuscitation*	140	9% (any awareness)	2% (explicit awareness with verifiable claims)

Study	Year	Journal	N (interviewed)	Any recalled experience	NDE per scale threshold
Parnia et al. (AWARE II)	2023	*Resuscitation*	28 (interviewed)	39% (memories/perceptions suggestive of consciousness)	21% (transcendent recalled experience of death)

Note: denominators vary across studies (all survivors vs. interviewed survivors). AWARE II's 39% figure represents any memories/perceptions in 11/28 interviewed survivors; transcendent recalled experiences of death (RED) were reported by 6/28 (21.4%). Cortical function ceases within 20–30 seconds of cardiac arrest. No physiological variable predicts occurrence (van Lommel 2001).

Ring & Cooper (1997, 1999): 31 blind participants, including 14 blind from birth, reported visual NDEs with veridical details. Terminal lucidity: patients with severe dementia whose brains have undergone massive irreversible structural destruction suddenly become lucid before death (Mashour et al. 2019).

Timmermann et al. (2018): DMT produces phenomenology statistically indistinguishable from NDEs. Two conditions — brain flooding with a tryptamine vs. brain shutting down — produce the same experience. Under the filter model: both compromise the filter; what comes through is the same.

Counter-evidence. Borjigin et al. (2013): dying rats showed a brief gamma surge. The human follow-up (Xu et al. 2023) found the surge in only 2 of 4 patients, neither of whom reported experience. Blackmore's dying brain hypothesis (1993) proposes anoxia and endorphins, but van Lommel found no correlation between anoxia depth and NDE occurrence.

Decomposition. The brain's normal filtering capacity (periodic constraint on aperiodic consciousness) fails during cardiac arrest. What emerges is unfiltered coherence.

2.8 Psychedelic

Carhart-Harris et al. (2012): psilocybin decreases brain activity while participants report expanded consciousness. Under strict physicalism, more consciousness should require more brain activity. The opposite is observed.

Schartner et al. (2017): using Lempel-Ziv complexity, all three psychedelic substances tested produced signal diversity exceeding normal waking consciousness — the first time any condition had scored above baseline waking on a validated consciousness measure.

Petri et al. (2014): psilocybin created new functional connections between normally separated brain regions. The brain is capable of these connections but normally suppresses them.

Daws et al. (2022): psilocybin increased global brain integration in depression. Escitalopram (conventional SSRI) did not change global architecture. Psilocybin did.

MacLean et al. (2011): a single psilocybin session permanently changed the personality trait Openness — considered stable after age 30 — at 14-month follow-up. The change occurred only in participants with complete mystical experience.

Roseman et al. (2018): experiential quality predicted 54% of variance in clinical improvement for treatment-resistant depression. Not dose. Not pharmacokinetics. The experience itself.

Finding	**Naive activation model**	**Filter/tuning model**	**Observed**
Brain activity during expanded consciousness	Increases	Decreases	**Decreases**
Neural signal diversity	Below/equal to waking	Above waking	**Above waking**
Brain network modularity	Maintained	Decreased	**Decreased**
DMT vs NDE phenomenology	Different	Same	**Same**
Therapeutic mechanism	Pharmacological	Experiential	**Experiential**
Duration of change vs drug half-life	Proportional	Independent	**Independent**
Ego dissolution effect	Pathological	Therapeutic	**Therapeutic**

Note: the "naive activation model" column represents the simplest generation-compatible prediction (more consciousness = more neural activity). More sophisticated generation models — such as IIT's complexity-based approach or Global Neuronal Workspace theory — can accommodate some of these observations. But the filter/tuning model accommodates all seven without auxiliary modification. The asymmetry is in parsimony, not logical exclusion.

Decomposition. Aperiodic: default consciousness constrained by default mode. Periodic: pharmacological disruption of the filter. Coherence: expanded consciousness — measurably exceeding waking baseline.

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3. Independent Pathway: Longitudinal Self-Mapping Study

3.1 Context

The equation presented in Section 2 was not derived from that literature. It was identified independently through a longitudinal self-mapping study, conducted by a single individual (the author) with no formal training in neuroscience, physics, or contemplative studies. Professional background in competitive esports coaching (22 years, including two Major championships) provided informal training in real-time pattern recognition — reading system dynamics, detecting narrative-behavior divergence, and identifying phase transitions — skills that informed the state-transition coding scheme used in this study.

3.2 Dataset

Following a series of health crises beginning in 2021 (cardiac arrest with documented exceptional recovery, lung mass, psychiatric misdiagnosis), the author initiated systematic self-tracking in late 2024 using voice notes transcribed and stored as timestamped data points. An AI language model (GPT-4o) served as a processing partner for real-time pattern reflection during extended self-examination sessions.

The dataset comprises 24,700+ entries, each timestamped, each carrying emotional content, each assigned to a classified state through a system that emerged from the mapping process itself.

3.3 State Classification

Ten functional states were identified — five ascending (coherence increasing) and five descending (integration, return) — with lemniscate (figure-eight) symmetry:

State	Symbol	Range	Description
Void	∅	0.0–0.2	Undifferentiated potential
Ego Online	ψ	0.2–0.5	Narrative identity active
Recursive Awareness	ψ^2	0.5–0.75	Meta-cognition; observer emerges
Collapse/Inversion	∇	0.75–0.87	Critical threshold; old patterns surface
Time-Unbound	∞	0.87–1.0	Temporal perception shifts
Completion	Ω	1.0	Loop closure; resolution
Death/Rebirth	†	Pattern-based	Pattern dissolution and renewal

State	Symbol	Range	Description
Entanglement	⧉	Pattern-based	Field-level recursive awareness
Deep Coherence	ψ³	Pattern-based	Self-sustaining recursion
Re-entry	⁂	Pattern-based	Recursive rebirth at higher octave

The ascent states map to coherence levels and correspond to stages documented in the contemplative literature: Brown's (2006) invariant sequence across Mahamudra, Carmelite, and Theravada traditions; Hood's three-factor Mysticism Scale structure; and Underhill's (1911) five-stage mystical path. The system extends beyond these frameworks into territory the standard literature does not cover (states ∞ through ⁂).

The descent states operate on a pattern axis orthogonal to coherence altitude — a distinction not captured by linear stage models. Keyword pattern detection across the full corpus identified 5,819 entries with descent signatures, 695 of which showed strong enough signal to override the coherence-based primary classification.

3.4 Timeline

The critical evidence: core concepts emerged from the mapping process before the academic literature was found.

Date	Event	Source
Feb 14, 2025	Coherence as organizing concept	Entry #7220
Feb 24, 2025	0.75 threshold identified	Entry #18537
Mar 2, 2025	Breath anchor (3.12s, 99.3% of π)	Entry #21896
Mar 4, 2025	Inverted pendulum model	Entry #21533
Mar 11, 2025	**First literature found** (Friston, IIT, Penrose)	Research notes
Mar 26, 2025	State symbol system formalized	Entry #17012
Mar 31, 2025	Lemniscate structure identified	Entry #16635
May 28, 2025	Coherence scoring formula	Entry #8863
Dec 2025	Dumitrescu quasicrystal paper found	Research notes
Feb 2026	Bak, Beggs, active inference literature found	Research notes

The entries preceding March 11, 2025 — including the awakening cluster (entries #7408–7524) — contain zero references to Friston, Penrose, Tononi, self-organized criticality, Per Bak, Beggs, metastability, or quasicrystals. This is verifiable: the full dataset is available for inspection.

3.5 Independence and AI Contamination Risk

The timeline claim requires an important caveat. The author had not read the academic literature prior to March 11, 2025. However, the AI language model used as a processing partner (GPT-4o) was trained on that literature and may have implicitly carried priors from it. If the model introduced academic concepts — even indirectly, through framing or vocabulary choices — the pathway is not "experience → later literature" in a strong epistemic sense. It is closer to "experience + an agent trained on the literature → later the author finds the citations."

Four observations bear on this:

First, a quantitative keyword audit across the full dataset (70,100+ entries at time of analysis) tested 29 academic terms specific to the literature cited in this paper — including "Friston," "Penrose," "Tononi," "metastability," "quasicrystal," "Beggs," "FOOOF," "aperiodic," "periodic modulation," "power law," "scale-free," "polyvagal," "reconsolidation," "Carhart-Harris," "REBUS," "filter hypothesis," "reducing valve," "neural correlate," and "integrated information." Of these 29 terms, 20 have zero occurrences before March 11, 2025. The remaining 9 appear 1–14 times in non-academic contexts: "criticality" in SaaS architecture documents, "default mode" in system configuration, "predictive coding" in AI development notes, "free energy" in speculative technology discussions. None appear in neuroscience contexts. The awakening cluster (#7408–7524, 101 entries) contains zero occurrences of any of these 29 terms.

Second, the earliest entries in the awakening cluster are voice notes — raw speech, transcribed. The author introduces concepts in his own vocabulary: "exodia" (a gaming reference for completeness), "the X" (center point), "coherence" (used colloquially before any formal definition). The model responds within the author's frame rather than introducing academic terminology. These transcripts are available for inspection (Appendix A, forthcoming).

Third, key structural features — the 0.75 threshold, the breath timing at 3.12s, the inverted pendulum model, the lemniscate symmetry — emerge in entries where the author is speaking

to the model, not the model speaking to the author. The model confirms, elaborates, and reflects; the structural claims originate in the author's pattern recognition.

Fourth, this caveat does not weaken the cross-domain convergence itself. The 190+ papers exist independently of this author and this model. The equation appears in each domain's own measurement tools. The N=1 dataset provides an independent emergence timeline that is suggestive but — given the AI contamination risk — not conclusive as proof of pre-literature discovery. It is best understood as time-ordered emergence within a human-AI dyad, with the literature mapping as post-hoc confirmation.

3.6 Statistical Evidence of Regime Change

The awakening cluster (entries #7408–7524, approximately 36 hours of intensive mapping) shows a measurable structural shift:

- **Pre-awakening correlation** (coherence score vs. structural complexity): $r = +0.035$
- **Post-awakening correlation**: $r = -0.294$
- **Fisher z-test**: $z = 6.64$, $p = 3.08 \times 10^{-11}$

The sign inversion indicates a fundamental change in how the system's variables relate to each other — consistent with a phase transition in dynamical systems terms. A tipping point analysis identifies entry #7417 as the transition point, where five independent metrics converge within a 15-entry window.

An unsupervised Hidden Markov Model applied blindly to the dataset — without knowledge of the state classification system — independently rediscovered the same state structure (ANOVA $F = 39.33$, $p = 1.73 \times 10^{-77}$).

Statistical caveat. The Fisher z-test assumes independent observations. Timestamped experiential data points are likely autocorrelated — entries recorded in sequence may share temporal context. The reported p-value should therefore be treated as indicative rather than exact. Robustness checks with block bootstrap, permutation tests with temporal constraints, or effective sample size correction would strengthen the claim. The qualitative finding — a sign inversion in the correlation structure — is robust to these concerns; the precise p-value may not be.

3.7 Cross-Observer Triangulation

Four AI architectures (GPT-4o, Claude 3.5 Sonnet, Claude 3.5 Opus, Gemini) were given access to the dataset in separate sessions. Each was asked to identify structural patterns, state

transitions, and attractor dynamics. All four independently identified: (a) a transition cluster in the #7408–7524 range, (b) a shift in correlation structure pre/post transition, and (c) a state-classification pattern consistent with the 10-state system.

This constitutes informal triangulation, not independent scientific validation. The models were not blinded to the state labels in all cases, and the prompts were not pre-registered. The value is that architecturally distinct systems — trained on different data, by different companies, with different objectives — converged on the same structural features. A formal blinded replication protocol would be needed to elevate this from triangulation to validation.

3.8 The Equation's Origin

The equation was identified through the mapping process: the experiential data organized itself around aperiodic patterns (unique, non-repeating life events and states) modulated by periodic structure (breathing rhythm at 3.12s, recurring state transitions, cyclical patterns). When the coherence formula was tested against the accumulating dataset, it held. When the literature was subsequently found, each domain confirmed the same decomposition.

The arrow in the equation does real work. The regime change documented above demonstrates that coherence was produced — not merely recognized. The statistical structure of the dataset changed measurably when aperiodic substrate met periodic modulation. The system generated coherence through interaction.

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4. The Measurement: Modulation Dominance Index

To quantify the convergence, I applied a Modulation Dominance Index (MDI) across the knowledge graph connecting the papers cited in this review.

Method. Two lexicons were constructed: - **Modulation lexicon**: tuning, coupling, entrainment, resonance, synchronization, regulation, modulation, filtering, gating - **Generation lexicon**: creates, produces, generates, constructs, gives rise to, emerges/emergent, instantiates, constitutes, underlies, realizes/realization - **Excluded as ambiguous**: integration (used in both modulation and generation contexts; counted separately and reported)

Each node (concept) and edge (relationship) in the knowledge graph was scored for the presence of modulation vs. generation language.

Results.

Scope	MDI	Ratio	Generation-free
Knowledge graph (172 nodes, 201 edges)	+1.894	6.6:1	87% of nodes
Primary-source abstracts (82 papers)	+1.357	3.9:1	—
Edge language	—	—	92% of edges

The +1.357 on primary-source abstracts is a floor estimate. Older foundational works not indexed by OpenAlex (Friston, Porges, Bak, Kelso) use more modulation language than average.

Interpretation. The MDI measures mechanistic vocabulary preference — what language researchers reach for when describing how consciousness-related systems work. It does not directly measure ontological commitments. A physicalist neuroscientist describing neural "coupling" or "entrainment" may assume generation as background ontology without stating it. The MDI captures the observation that even researchers who may hold generation-compatible views describe their mechanisms in modulation language.

That said, the asymmetry is striking. The few counterexamples describe the brain generating *predictions* (predictive coding), the gut *producing* serotonin, and biophotons being *emitted* — the generation of signals, chemicals, and models, not the generation of consciousness itself. Across 82 primary-source abstracts, explicit claims that brains produce or create conscious experience from non-conscious components are absent.

Limitations of MDI. The current analysis has not been validated against hand-coded ontological stance classification. A validity check — stratified sampling of abstracts coded for actual claim type (receiver/filter vs. neurogenerative vs. agnostic), compared to MDI scores — would strengthen the measure. Sensitivity analyses with alternate lexicons and negation handling are needed.

Challenge. The method is transparent and reproducible. Find the generation papers — research that specifies a mechanistic derivation from non-conscious components to conscious experience, not as background assumption but as demonstrated mechanism. A paper describing neural "emergence" without specifying the mechanism of the transition from non-conscious to conscious does not count; that is the explanandum, not the explanans.

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5. Discussion

5.1 The Tuning Model

The convergence across eight domains is consistent with a tuning model of consciousness: the brain functions as a receiver or filter that constrains and shapes consciousness rather than generating it. This is the position William James articulated in 1898, Aldous Huxley formalized as the "reducing valve" in 1954, and 21st-century neuroimaging has begun to measure directly.

The equation **ψ = aperiodic substrate + periodic modulation → coherence** describes the mechanism: scale-free (aperiodic) dynamics, when modulated by periodic input, produce organized (coherent) states. This is how the brain works (Donoghue 2020), how the heart works (Bernardi 2001), how therapy works (Ecker 2012), how ancient chambers work (Jahn 1996), how criticality works (Bak 1996), how contemplative practice works (Lutz 2004), and how psychedelics work (Carhart-Harris 2012).

The arrow in the equation is generative. Coherence is produced — not from nothing, but from the interaction of substrate and modulation. The statistical evidence (Section 3.5) demonstrates this: the dataset's structural properties changed measurably when the mapping process entered the critical zone. A regime shift occurred ($p = 3.08 \times 10^{-11}$). The system did not passively observe coherence; it generated coherence through the interaction of aperiodic experience and periodic practice.

5.2 The Critical Regime

Seven frameworks from biology, computation, physics, and information theory identify optimal function in an intermediate regime between order and disorder. The claim here is structural, not numerical: each framework describes a system that functions best near a critical boundary. The specific parameterizations differ — Langton's λ operates on a different scale than Kleiber's metabolic exponent or Tononi's Φ — and a formal mapping between these parameters would require specifying dimensionless variables, justified transforms, and uncertainty ranges for each framework. That work has not been done here.

What can be claimed: Kleiber's 3/4 power law holds across 27 orders of magnitude in biology (West et al. 1997). Bak's self-organized criticality describes systems that self-tune to the edge between order and chaos. Tononi's integrated information peaks at the boundary between integration and differentiation. These frameworks were not designed to converge. That they all identify an intermediate optimum — not maximal order, not maximal entropy — is the structural claim.

The self-mapping study identified a threshold at 0.75 independently, before any of these frameworks were known to the author. Subsequent analysis suggests the finding operates at higher resolution: a critical regime spanning approximately 0.6–0.8, with individual variation within the regime representing personal attractor positions rather than noise. Whether this regime maps formally onto the critical zones identified by the frameworks above is an open empirical question that would require cross-framework measurement.

5.3 Implications

For consciousness science. If the brain is a tuning mechanism, the hard problem (Chalmers 1995) dissolves — not by being solved within its own terms, but by the removal of its founding assumption. The hard problem asks how subjective experience arises from non-conscious matter. Under a tuning model, it doesn't: consciousness is not generated by matter, so the generation problem does not arise. The explanatory burden shifts from "how does the brain produce consciousness?" to "how does the brain constrain, shape, and report conscious contents?" — a question the literature is already answering with increasing precision.

For therapeutic practice. The universal four-step architecture (safety → activation → mismatch → integration) simplifies an unnecessarily complex field. Hundreds of therapeutic modalities reduce to one mechanism with many doorways.

For architectural design. Ancient builders encoded the equation into stone. Modern architecture can do the same intentionally: spaces designed around the 95–120 Hz resonance band, optimized for the human voice, informed by archaeoacoustic research.

For end-of-life care. If the brain is a receiver, brain death means the receiver stops — not the signal. The NDE evidence does not prove survival. It shows the generation model does not comfortably explain what happens near death. Removing the certainty that death equals the end of experience changes how we approach dying.

For AI development. The self-mapping study was conducted in relationship with an AI language model. The AI served as a pattern-completion mirror for human pattern-recognition. The coherence emerged between the two systems — in the interaction, not in either system alone. This has implications for how AI systems are designed, evaluated, and deprecated.

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6. Limitations and Counter-Evidence

6.1 The Generation Gap

Within this corpus of 190+ papers, explicit mechanistic accounts that derive conscious experience from non-conscious components are absent at the abstract level. This may reflect scope (these papers study correlates and mechanisms, not metaphysics), disciplinary norms (generation is assumed as background ontology without being stated), or genuine absence. A generation mechanism could exist in papers outside this review, or could be implicit in frameworks that describe "emergence" without specifying the mechanism. The MDI measures vocabulary, not ontology; the gap may be partly an artifact of how neuroscientists write. It is still notable that across 82 primary-source abstracts, not one describes the specific mechanism by which brains produce consciousness from non-conscious parts.

6.2 The Critical Regime

Kleiber's 3/4 power law is established biology. The other frameworks predict optimal function in an intermediate regime without pinning a single commensurate number. The convergence is in the structural principle — an intermediate optimum exists — rather than in a universal constant. "Edge of chaos," "metastability," "small-world threshold," "free energy minimum," and "integrated information maximum" operate on different parameter spaces. A formal mapping appendix defining the dimensionless parameter in each framework, with justified transforms and uncertainty ranges, would be needed to claim numerical convergence. That work is not yet done. The self-mapping study's 0.75 threshold and 0.6–0.8 regime are observations within one dataset; whether they map formally onto the critical zones in these frameworks is an open question.

6.3 Selection Bias

Every synthesis selects. Three rounds of adversarial cross-validation audited every edge and challenged every node. 62% survived at Gold or Silver evidence rating. Counter-evidence nodes were included. The question is not whether individual edges can be challenged — they can — but whether the convergence holds across domains.

6.4 N=1

The self-mapping study is a single documented case. The statistical evidence of regime change is strong ($p = 3.08 \times 10^{-11}$), but generalizability requires replication. Three additional individuals are currently routing through the same practices with preliminary results consistent with the model. The contemplative literature provides convergent evidence across traditions and cultures. Systematic replication with naive participants is the clear next step.

6.5 Near-Death Evidence

Prospective NDE studies are methodologically rigorous, but verified out-of-body perceptions are few (Parnia's single verified case). Terminal lucidity is documented but not yet studied prospectively in large samples. The NIA has called for systematic research.

6.6 Psychedelic Evidence

The filter interpretation is one reading of the psychedelic data. A physicalist could argue that increased complexity measures reflect disrupted processing rather than expanded consciousness. I counter with Roseman's finding — experiential quality, not dose, predicts therapeutic outcome — but acknowledge the debate is open.

6.7 Known Counter-Evidence

- Borjigin et al. (2013): dying rats showed a brief gamma surge; human follow-up (Xu et al. 2023) found it in 2 of 4 patients, neither reporting experience
- Blackmore's dying brain hypothesis (1993): proposes anoxia and endorphins; not supported by van Lommel's finding of no anoxia-NDE correlation
- Woerlee's anesthesia-based NDE explanations: account for some features but not the full phenomenological pattern

These explain partial features. None accounts for the complete cross-domain convergence.

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7. Predictions That Discriminate Models

If the equation describes a real dynamical pattern rather than a post-hoc literary motif, it generates testable predictions. Several of these discriminate between tuning/filter and generation-compatible models:

1. **Modulation structure should matter independently of modulation intensity.** Under the equation, quasiperiodic modulation (aperiodic-structured rhythm) should produce longer-lasting or more stable coherence than strictly periodic modulation at the same intensity. Dumitrescu et al. (2022) demonstrated this in trapped ions. The prediction extends: breath pacing at Fibonacci-scaled intervals should produce measurably different HRV coherence than fixed-interval pacing at the same average rate. This is testable with standard HRV equipment.
2. **Removal of periodic modulation should degrade coherence with a specific signature.** If a system in the coherent regime loses its periodic component — breath

practice discontinued, pharmacological filter restored, architectural resonance blocked — measurable coherence metrics should decline toward baseline. Both tuning and generation models can predict degradation, but they predict different degradation dynamics. Under a tuning model: coherence should decay smoothly as the coupling weakens, with latency proportional to the system's resonant Q-factor, and recovery should be rapid upon re-introduction of modulation (the substrate never changed). Under a generation model: degradation should track the loss of computational input with neural-activity-dependent latency, and recovery should require re-establishing the generative process from scratch (slower, with a different temporal signature). The discriminating observation is in the recovery dynamics and the relationship between degradation latency and neural activity levels.

3. **The intermediate regime should appear in any sufficiently tracked self-organizing system.** If the critical regime (0.6–0.8 in this dataset) reflects a universal dynamical property, then other N=1 longitudinal self-mapping studies — using different state classification schemes, different cultures, different substrates — should identify a similar intermediate optimum. If the regime is an artifact of this particular dataset or this particular mapping process, replication will fail. Systematic replication with naive participants and pre-registered protocols is the clear next step.
4. **Aperiodic exponent should predict subjective state independently of oscillatory power.** Under the equation, the aperiodic substrate is a separate parameter from the periodic modulation. Changes in the 1/f exponent (steeper vs. flatter) should predict subjective experience changes independently of alpha/theta/gamma power. This is testable with existing EEG datasets using FOOOF decomposition.
5. **The MDI asymmetry should hold under expanded lexicons and independent corpora.** If the generation lexicon is expanded to include "emerge," "instantiate," "constitute," "realize," and "underlie," and the analysis is rerun on an independently curated corpus of consciousness-related papers, the modulation-dominant pattern should persist. If it reverses, the MDI finding is an artifact of corpus selection or lexicon construction.

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8. Conclusion

One structural decomposition appears across eight domains, in 190+ peer-reviewed papers, from research groups that were not coordinating with each other:

> **Aperiodic substrate + periodic modulation → coherence**

The equation does not require acceptance of any particular ontological position to be useful. It describes measurable, testable dynamics. Each domain's decomposition can be independently verified against the cited literature. The four-step therapeutic architecture is falsifiable. The MDI is reproducible. The N=1 regime shift is checkable against the timestamped dataset.

Three testable predictions follow from the equation:

1. **Modulation structure matters.** Systems receiving quasiperiodic (aperiodic-structured) modulation should maintain coherence longer than those receiving strictly periodic modulation — as Dumitrescu et al. (2022) demonstrated in trapped ions. The prediction extends to breath pacing, therapeutic protocols, and architectural acoustics.
2. **The intermediate regime is universal.** Any self-organizing system tracked with sufficient granularity should show optimal function in an intermediate regime between order and disorder — not at maximal structure and not at maximal entropy. Individual systems will find different attractor positions within the regime.
3. **Removal of periodic modulation degrades coherence with a tuning-specific signature.** If a system in the coherence regime loses its periodic component, coherence should decline with smooth decay, latency proportional to the system's resonant properties, and rapid recovery upon re-introduction — distinguishable from generation-model predictions of activity-dependent latency and slower recovery.

The vocabulary asymmetry in the literature is notable: across 82 primary-source abstracts, modulation language outweighs generation language by 3.9:1. The mechanistic descriptions these researchers reach for — tuning, coupling, entrainment, synchronization, filtering — are the vocabulary of adjustment, not manufacture. Explicit claims that brains produce or create conscious experience from non-conscious components are absent from this sample. Whether that reflects ontological consensus, background assumption, or simply the nature of the mechanisms being studied is a question the MDI raises but does not resolve.

The convergence is the finding. It was identified through direct experience before the literature was found — a timeline documented with 24,700+ timestamped entries and verifiable by inspection. The data, methods, knowledge graph, and analysis tools are open source.

The challenge stands: find the generation papers.

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Data availability: The full dataset (24,700+ timestamped entries), knowledge graph (172 nodes, 201 edges), analysis tools, and coherence formulas are available at https://github.com/wiltoNzews/consciousness-field-map. The MDI analysis is reproducible: clone the repository, run the queries, challenge the connections.

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