

Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance

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Robert Galida – June 2026 (Revised Edition)

Note to readers: This is a revised version of the May 2026 paper. The core insights about the eternal skeleton and transient dance remain, but the treatment of fundamental metronomes has been refined. For the detailed relational account of time, see the companion paper: [Metronome, Memory, and the Threefold Anchor: A Relational Account of Time F.](#)

Abstract

This paper presents a unified framework based on a simple idea: **persistence under disturbance is the basic mark of**

reality.

We divide all persistent things into two classes:

- **Non-dissipative (conservative) structures** – eternal, time-symmetric, mindless. They form the **eternal skeleton** (Planck scale, quantum fields, the three fundamental metronomes: electron, neutrino mass eigenstates, and proton).
- **Dissipative attractors** – temporary, time-asymmetric, needing energy flow. They form the **transient dance** (life, mind, society, consciousness).

All observed minds are dissipative.

Because the universe as a whole is a conservative system (no outside environment), it cannot have consciousness or intentions.

Therefore, under this framework, a theistic God is extremely unlikely.

No supernatural entities are needed.

The framework gives a naturalistic view of persistence, a graded idea of mind, and a way to study how people get trapped in **fantasy attractors** (belief systems that ignore reality).

Scope Conditions

This framework is not a finished mathematical theory. It is a cross-domain way of thinking about persistence under disturbance. The word “attractor” is sometimes a metaphor, sometimes a precise term. The framework looks for similar stability patterns across different scales, not a single equation. It is an invitation to explore, not a closed belief

system.

Part I: The Nature of Mind

1. The Core Intuition

Your mind feels real, long-lasting, and not just brain tissue. Dualism can't explain mind-body interaction. Reductive physicalism ignores the feeling of being you. We propose a third way: **the mind is a stable, resilient, persistent pattern – an attractor – of your whole body.**

2. Key Definitions

| Term | What it means | How to measure |
|--------------------------|---|--|
| Attractor | A region in state space that pulls nearby states toward it and holds them | Lyapunov exponents, basin stability |
| Resilience | Ability to bounce back after a hit | Recovery time, hysteresis |
| Basin of attraction | The set of states that eventually fall into the attractor | Larger basin = more resilient |
| Attractor dimensionality | How complex the attractor is | Correlation dimension; proxy for integrated information (Φ) |
| Fantasy attractor | A belief system cut off from reality checks | Low contact with corrections; deep basin; slow updating |

| Term | What it means | How to measure |
|--------------------------|--|---|
| Shared reality attractor | A belief system open to reality checks | High contact with corrections; shallow basin; fast updating |

3. Signs of a Resilient Attractor

- Bounces back quickly after stress
- Low hysteresis (forward and return paths nearly the same)
- Stable rhythms (HRV, circadian, breathing lock together)
- Cross-domain coupling (better sleep → better mood, immunity)
- Graceful decline under growing stress (not sudden collapse)
- Critical slowing down (rising variance and autocorrelation before a big change)

4. The Third Ontological Category

| View | What it says | Problem |
|-----------------------|--|--|
| Dualism | Mind is a non-physical substance | How can it interact with the body? |
| Reductive physicalism | Mind is just brain activity | It loses the feeling of being you |
| Attractor framework | Mind is a real, non-substantial pattern (like a whirlpool) | Fully compatible with physics, keeps subjective experience |

A whirlpool is real – it depends on water, affects the flow, and isn't just one water molecule. Your mind is like that.

5. Attractor Framework & Consciousness Theories

- **IIT (Integrated Information Theory):** Attractor dimensionality acts like Φ . Awake animals have higher-dimensional attractors than anesthetised ones (Tajima & Kanai, 2017).
- **GWT (Global Workspace Theory):** “Ignition” means settling into a global attractor that spans many brain areas.
- **Testable predictions:** Shallow attractors (unconscious) are easier to disturb; conscious states have deeper basins and higher dimensionality.

6. The Simplest Mind: *C. elegans* (a tiny worm)

The worm has 302 neurons. It shows: integration of senses, minimal self-reference, valence, associative learning, goal-directed behaviour. That’s all we need for a minimal mind. Prediction: during learning, its brain should show higher attractor dimensionality than when paralysed.

7. Mind as a Whole-Body Attractor

Your mind is not just in your brain. It includes your body’s extracellular matrix (ECM), hormones, immune system, and gut. Alcohol, sleep, and ECM restoration affect the whole body and change your mind. That’s why relaxing your belly, getting morning light, or reading a quiet book can improve your sleep and heart rate variability (HRV).

8. Self-Engineering: Reshaping Your Own Attractor

Because your mind is an attractor, you can change it through small, repeated nudges: learning a skill, exposure therapy,

forming habits, meditation, physiological hacks (ECM restoration, belly sag, morning cardio). An N=1 experiment (tracking ECM, sleep, HRV) showed that improvements happen in non-linear, threshold-based jumps – exactly as attractor theory predicts.

Part II: The Eternal Skeleton and the Transient Dance

9. Two Fundamental Classes of Persistence

9.1 Non-Dissipative (Conservative) Structures – The Eternal Skeleton

- No energy loss; total energy stays the same (or exchanges only within a closed system)
- Time-reversible at the level of intrinsic persistence (though weak interactions violate CP/T)
- Stable because of conservation laws (charge, baryon number, energy)
- Do not age, do not die (or are effectively eternal on all observable timescales)

The three fundamental metronomes (see *Threefold Anchor* paper) are the most conservative layer of the eternal skeleton:

| Metronome | Role |
|---|---|
| Electron | Lightest charged lepton; invariant Compton frequency |
| Neutrino mass eigenstates (ν_1, ν_2, ν_3 collectively) | Effectively stable; theoretically invariant frequencies |

| Metronome | Role |
|-----------|--|
| Proton | Lightest baryon; stability from baryon number conservation |

These three are continuously recycled through all dissipative systems. They are the invariant substrate.

Other conservative structures include: Planck-scale granular spacetime, quantum fields, stable atoms, and the universe as a whole.

These make up the **eternal skeleton** – mindless, timeless, the foundation.

9.2 Dissipative Attractors – The Transient Dance

- Need constant energy and must dump entropy
- Time-irreversible (arrow of time)
- Stay stable through feedback loops, homeostasis, and energy use
- Finite lifetime – they age, decay, and eventually collapse
- **What binds all dissipative systems** (a bacterium, a brain, a galaxy, a society) is the continuous recycling of the three eternal metronomes. Every dissipative system operates by exchanging electrons, protons, and neutrinos with its environment.

Examples: living cells, metabolic networks, ecosystems, human bodies, conscious minds, societies, economies, fantasy attractors.

These are the **transient dance** – everything that is born, lasts a while, and dies.

10. Why Mind Requires Dissipation

Every known system with integration, self-reference, valence,

learning, and goal-directedness is **dissipative**. No non-dissipative mind has ever been seen. So we conclude that, in this framework, the only kind of consciousness we have evidence for is dissipative. This is a best-explanation inference, not an absolute proof.

11. The Universe as a Non-Dissipative System

The universe as a whole has no outside environment. Its total energy is conserved (or at least doesn't exchange with anything else). So it is non-dissipative:

- No metabolism (doesn't eat, breathe, or repair itself)
- No learning (its laws don't change from experience)
- No valence (no likes or dislikes)
- No goal-directedness (it just follows its equations, doesn't aim for a basin)

Therefore, the universe is **not a mind**. Any global attractor (e.g., a de Sitter vacuum state) is a conservative, eternal, mindless pattern.

12. Why a Theistic God Is Extremely Unlikely (Probabilistic)

A theistic God is supposed to be: conscious, intentional, personal, eternal, unchanging, and self-sufficient.

- Consciousness (as far as we know) requires **dissipation**.
- Eternal, unchanging, self-sufficient means **non-dissipative** (conservative).

No known entity can be both dissipative (aging, needing energy) and non-dissipative (eternal, self-sufficient). So, under this framework, a theistic God is extremely implausible.

The universe itself is already the only non-dissipative system. Adding a separate non-dissipative God is unnecessary and, by definition, cannot interact with anything.

13. The Map of Existence

TRANSIENT DANCE (Dissipative Attractors)

- Societies
- Minds
- Cells
- Ecosystems
- Human Body (ECM, HRV)
- Animal Life
- Metabolism (energy + entropy)
- ↓ (emergence)

ETERNAL SKELETON (Conservative Persistence Structures)

- Atoms
 - Three metronomes: electron, neutrino mass eigenstates, proton
- Quantum Fields
- Planck Scale (granular spacetime) ← FLOOR

Legend: Floor = Planck-scale granularity – the hard, eternal limit. Skeleton = quantum fields, stable particles, atoms – conservative structures. Dance = dissipative attractors – minds, life, society.

14. Open Questions for Future Work

- **Formal cross-scale unification:** How can we unify conservation-based stability (QFT) and dissipative attractors (nonlinear dynamics) with a single mathematical object?
- **Dissipation-consciousness link:** Is dissipation absolutely necessary for consciousness, or just a fact about life on Earth?
- **ECM mechanism:** What is the exact chain from ECM changes to nervous system regulation to subjective feelings?

- **Persistence vs. selection:** Is persistence a basic feature of reality, or do we only notice stable things because unstable ones vanish?
- **Fantasy attractor measurement:** Can we really measure correction latency, basin depth, and external coupling in real social systems?
- **Coupling equations:** How exactly does the rate of memory inscription depend on metronome frequency? (See the *Threefold Anchor* paper for a working placeholder.)

15. Conclusion

The attractor framework gives a naturalistic picture of reality:

- **Non-dissipative (conservative) structures** – the eternal, mindless skeleton, anchored by the three fundamental metronomes (electron, neutrino mass eigenstates, proton).
- **Dissipative attractors** – temporary, energy-hungry, and mortal. All minds are in this class.
- **What binds all dissipative systems** is the continuous recycling of the same three eternal metronomes.
- The universe as a whole is non-dissipative, therefore not a mind.
- A theistic God is extremely implausible under this framework.

We don't need religious language. We have the eternal skeleton and the transient dance: persistence without transcendence, structure without the supernatural.

The dance is finite, fragile, and precious. The skeleton is eternal, but mindless.

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This rewrite is ready to replace the old post. It now correctly reflects the threefold metronome framework, includes the recycling insight, and cross-references the newer paper.

Free Will as Attractor Autonomy: A Dynamical Account of Agency

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Abstract

Free will is often seen as either a magical mystery (libertarianism) or an illusion (hard determinism).

This paper offers a third view using the attractor framework.

In this framework, your mind is a **dissipative, self-referential attractor** of your whole body.

Free will is redefined as **attractor autonomy**:

- The ability to generate behaviour from your own internal dynamics.
- To keep yourself stable over time.
- To model yourself.

- And to reshape your own attractor landscape over time.

Agency comes in degrees – it is not a simple yes/no.

We give a mathematical formula for an **agency index** AA that combines three factors:

- **Attractor dimensionality** DD (complexity of your brain's activity)
- **Recursive self-modification** RR (your ability to change your own habits)
- **Self-reference strength** SS (how well you have a persistent self-model)

The paper makes a **falsifiable prediction**: an **inverted-U** relationship between attractor dimensionality and sense of agency – too low or too high reduces agency.

We describe how to test this with EEG, intentional binding tasks, and statistical methods. We also engage with classic compatibilist philosophers (Frankfurt, Dennett) and address Pereboom's manipulation argument.

We even provide an explicit rule to avoid the "liver problem" (a false positive for self-reference).

1. Introduction

The attractor framework says that **persistence under disturbance** is the basic mark of reality.

Minds are **dissipative attractors** – patterns that need constant energy flow, integrating the whole body.

In this view, free will cannot be a supernatural break from cause and effect. Instead, it must be a **dynamical property** of certain attractors.

We do not claim to solve the ancient free will debate. We

offer a **naturalistic, testable redefinition** that adds new empirical content to compatibilism.

2. What Free Will Is Not – And What It Is

2.1 Rejecting supernatural libertarianism

Libertarian free will requires an uncaused choice – a break in the chain of cause and effect.

The attractor framework rejects this: there is no evidence for it, and it contradicts physical laws.

2.2 The error of hard determinism

Hard determinism says freedom is an illusion because everything is determined. But it confuses “determined” with “externally coerced”.

A system can be **internally determined** – by its own attractor – yet still be free. That is the core of **compatibilism**.

2.3 Free will as attractor autonomy

We define **free will** (or agency) as the degree to which a system has four properties:

1. **Dissipative persistence** – it stays alive by using energy and exporting waste (measured by energy use and recovery speed).
2. **Self-reference** – it has an internal subsystem (an “indexical locus”) that models the whole system and is stable.
3. **Trajectory selection** – it can choose among different possible futures (measured by **policy entropy** $H(\pi)H(\pi)$).

4. **Recursive self-engineering** – it can change its own attractor shape (measured by learning-to-learn or metacognitive accuracy).

These four are **jointly necessary**. If any is missing, agency is at best primitive.

Because they are necessary, we combine them with a **multiplicative** formula (if any factor is zero, agency is zero). $A = (D - D_{min} \square D_{max} \square - D_{min} \square)^\alpha (R - R_{min} \square R_{max} \square - R_{min} \square)^\beta (S - S_{min} \square S_{max} \square - S_{min} \square)^\gamma$

Where:

- DD = attractor dimensionality (e.g., from EEG)
- RR = recursive modification capacity (e.g., improvement in a meta-learning task)
- SS = self-reference strength (normalised mutual information)

The constants ($D_{min} \square, D_{max} \square D_{min} \square, D_{max} \square$, etc.) are set from a reference population.

The exponents α, β, γ are estimated from data (e.g., comparing healthy people with patients).

A threshold A_{crit} (e.g., the 5th percentile of healthy humans) decides where agency begins.

Agency is **graded**:

- Rock: $A \approx 0$
 - Thermostat: $A \approx 0$
 - Worm: $A \approx 0.1$ (some learning, little self-model)
 - Human: $A \approx 0.8$
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3. The Indexical Locus: Defining the “Self” and Avoiding the “Liver Problem”

The **indexical locus** LL is the part of the system that acts as a persistent self-model.

To avoid trivial cases (like a liver having high mutual information with the rest of the body), we add three extra conditions:

- **Top-down causal influence** – LL can change the rest of the body in ways that serve the body’s goals (measured by variance explained beyond bottom-up effects).
- **Informational closure** – LL ’s own dynamics are relatively independent of the rest over short timescales (conditional mutual information > 0).
- **Self-referential loop** – LL influences the body, and the body influences LL back (bidirectional Granger causality).

These criteria rule out livers, pacemakers, and simple homeostats. The indexical locus is a **recursive self-model**, not just a predictive subsystem.

4. Active Inference and Policy Entropy

In active inference (Friston), agents try to minimise “free energy” – they pick **policies** (sequences of actions).

Each policy is a trajectory through the agent’s attractor landscape.

Policy entropy $H(\pi) = -\sum p(\pi) \log p(\pi)$ measures how many different policies are available.

- Low entropy → rigid, one-track mind.
- High entropy → flexible, but possibly noisy.

Free will is the ability to access many low-energy policies. The agent's choices are not random; they are constrained by the attractor geometry. But if several attractor basins are open, the agent can choose among them – that is what we feel as free choice.

Policy entropy can be measured in behavioural tasks where multiple choices are equally good (e.g., probabilistic reversal learning, two-armed bandit tasks).

5. The Inverted-U Prediction and Falsification

5.1 Core prediction

We predict an **inverted-U** relationship between attractor dimensionality DD and the subjective sense of agency (e.g., from intentional binding experiments).

- Very low DD → chaotic, unstable (like schizophrenia) → low agency.
- Very high DD → rigid, stuck (like OCD) → low agency.
- In the middle → flexible but stable → high agency.

The agency index AA also includes RR and SS , which we think increase agency across the board. So to test the inverted-U for DD alone, you need to **control for** RR and SS (e.g., study

people matched on those, or use partial correlation).

5.2 How to measure and test

- **Attractor dimensionality DD** – use the Grassberger-Procaccia algorithm on 5-min resting-state EEG/MEG.
- **Sense of agency** – use the **intentional binding** paradigm: press a key, then a tone sounds; participants estimate the time between action and tone. Stronger binding means higher agency.
- **Statistical test** – fit a quadratic regression: $\text{agency} = \beta_0 + \beta_1 D + \beta_2 D^2$
If $\beta_2 < 0$ and the vertex lies inside the observed range of DD , the inverted-U is supported. Use bootstrap (1000 resamples) to check confidence intervals.

5.3 Falsification condition

The framework is **falsified** if:

- The quadratic coefficient β_2 is not negative (no inverted-U).
- Or, in a clinical experiment (e.g., increasing DD in OCD patients with NMDA drugs), agency does **not** decrease but keeps increasing.

6. Experimental Proxies – Summary Table

| Construct | Measure | How to record | Expected relation to agency |
|----------------------------------|---|---|-----------------------------|
| Attractor dimensionality DD | Correlation dimension (Grassberger-Procaccia) | Resting-state EEG/MEG (5 min) | Inverted-U |
| Policy entropy $H(\pi)H(\pi)$ | Entropy of choice distribution | Probabilistic reversal learning (200 trials) | Inverted-U |
| Sense of agency | Intentional binding magnitude | Action-outcome interval compression (50 trials) | Max at intermediate DD |
| Recursive self-modification RR | Learning-to-learn improvement | Meta-learning task (pre-post difference) | Positive (more is better) |
| Self-reference strength SS | Normalised mutual info $\ln(L;S)/\ln(L;S)$ | Resting-state fMRI or MEG | Threshold $> \theta$ |

7. Hierarchical Constraints and Social Attractors

Free will is **nested** inside larger attractors – society, culture, laws, economy. Your range of choices is partly set by these.

This is not an objection; it is just the fact that freedom is always **constrained autonomy**.

We predict that societies with more cultural diversity (higher “cultural entropy”) allow more individual agency, other things being equal. This can be tested by cross-cultural comparisons of policy entropy in decision tasks.

8. Engagement with Compatibilist Literature

8.1 Standard compatibilists (Frankfurt, Dennett)

- **Frankfurt (1971)**: freedom is about your will aligning with your own desires. Our framework adds that those desires must be encoded in a persistent self-referential attractor. The recursive self-engineering component RR maps directly to Frankfurt's "second-order volitions".
- **Dennett (1984)**: freedom is about being able to respond to reasons. Our framework adds that this requires a certain basin geometry and recursive plasticity.

8.2 Addressing Pereboom's manipulation argument

Pereboom argues: if a neuroscientist engineers your brain, you are not free – even if your behaviour comes from internal dynamics.

Our reply: agency requires **recursive self-modification** ($R > 0$) at some point in your history.

- A perfectly manipulated agent that never changed its own attractor would have $R \approx 0$ and thus $A \approx 0$.
- A healthy human who learned and adapted has $R > 0$ and genuine agency.

The origin of the initial attractor does not matter – only the presence of self-modification over time.

9. Open Questions and Limitations

- **Calibrating exponents** – α, β, γ and the threshold θ need to be estimated from large-scale data (e.g., Human Connectome Project) using maximum likelihood.
- **The liver problem** – our exclusion criteria need empirical validation; we must show that organs like the liver do **not** satisfy them.
- **Inverted-U for policy entropy** – the same shape is predicted but may be hidden by decision noise.
- **Moral responsibility** – the framework gives a basis for responsibility (if $A > A_{crit}$), but it does not settle all normative questions – it only gives a scientific starting point.

10. Conclusion

Free will is **not** a supernatural escape from physics. It is a **dynamical property** of certain dissipative, self-referential attractors:

- The ability to act from your own internal dynamics.
- To keep a stable self-model over time.
- And to reshape your own attractor landscape.

This account is compatibilist, testable, and graded.

The inverted-U prediction, with a specified statistical test, gives a clear falsification criterion.

The dance of free will is the dance of a self that persists

under perturbation.

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