

Symmetric Projection Attractor Reconstruction as a Cardiac Attractor: Structural Parallels with the Attractor Framework

Robert Galida

Independent Researcher

June 2026

fantasyattractor.com

Abstract

The attractor framework proposes that persistence under perturbation is a fundamental marker of reality, with corrective permeability (κ) serving as a proposed multi-dimensional measure of a system's capacity to return to its attractor after perturbation. Bonet-Luz et al. (2020) developed Symmetric Projection Attractor Reconstruction (SPAR), a patented mathematical method that reformulates the entire electrocardiogram (ECG) waveform into a bounded, symmetric, 2-dimensional attractor and extracts quantitative features from it. Applied to mice with an *Scn5a*^{+/-} mutation linked to Brugada syndrome, SPAR features achieved 96% classification accuracy—substantially outperforming standard ECG intervals and amplitudes. This paper identifies structural parallels between SPAR's attractor-based analysis and the attractor framework. The SPAR attractor is a concrete, computable attractor derived from a physiological signal, and a provisional mapping is proposed between specific SPAR

features and proposed components of κ . The parallels are post-hoc and do not constitute independent validation of the framework. The framework's κ remains qualitatively defined; this mapping is offered as a contribution to its ongoing development.

1. Introduction: Attractor-Based ECG Analysis

The attractor framework (Galida, 2026a, self-published May 2026 at fantasyattractor.com; no DOI) proposes that dissipative attractors—stable configurations toward which systems converge and from which they resist displacement—are the fundamental units of persistent organization across physical, biological, cognitive, and social domains. Corrective permeability (κ) is a proposed multi-dimensional measure of a system's capacity to return to its attractor after perturbation. The framework distinguishes between the attractor (the invariant set of states toward which the system converges) and the basin (the set of initial conditions that converge to that attractor). In the present paper, we use “attractor” in the standard dynamical systems sense and note where the framework's usage aligns or diverges.

In 2020, Bonet-Luz, Aston, Nandi, and colleagues published a study in *Heart Rhythm 02* (Elsevier) applying Symmetric Projection Attractor Reconstruction (SPAR) to murine electrocardiograms (Bonet-Luz et al., 2020). SPAR is a patented mathematical method that reformulates the entire ECG waveform into a bounded, symmetric, 2-dimensional attractor, preserving all available waveform morphology rather than extracting only a few fiducial points. The method was applied to distinguish wild-type mice from those carrying an *Scn5a*+/- mutation linked to Brugada syndrome, a hereditary condition associated with sudden cardiac death.

The study did not cite the attractor framework and was conducted within the established traditions of biomedical signal processing, nonlinear dynamics, and machine learning. This paper identifies structural parallels between SPAR's attractor-based analysis and the attractor framework. The parallels are post-hoc and do not constitute independent validation.

2. The SPAR Method

SPAR generates a 2-dimensional attractor from approximately periodic signals such as ECG, blood pressure, or photoplethysmogram waveforms. The method determines an average cycle length from the signal, sets a time delay parameter as one-third of that cycle, and plots the data in a bounded box using a symmetric projection. The resulting attractor is a compact, easily visualized representation of the entire waveform morphology, overlaid with a density map indicating which regions are visited more or less frequently. The method factors out changes in heart rate and baseline variation to concentrate on waveform morphology.

For murine lead I and II ECG signals, the SPAR attractor typically exhibits 3 long arms predominantly representing the R peak, with deep S peaks and sometimes deep Q peaks producing shorter arms in the opposite direction, yielding an attractor with up to 6 arms in total (Figure 1 of the original paper). The central core region reflects T-wave and P-wave morphologies.

From this attractor, Bonet-Luz et al. extracted 74 manually defined features relating to the density, size, and symmetry of the attractor, along with the average heart rate and a vertical normalization scaling factor. These features were used in a k-nearest neighbors classifier ($k=3$) with leave-one-

animal-out cross-validation.

The dataset comprised ECG recordings from 42 anesthetized mice (39 lead I, 39 lead II) of varying genotype (wild-type vs. *Scn5a*^{+/-}), sex, and age. Each signal was divided into 13 non-overlapping 10-second windows, yielding 1,014 records for classification. Standard ECG intervals (7) and amplitudes (6) were also extracted for benchmarking. It is important to note that the effective sample size for the classification is 42 animals, not 1,014 windowed records, and the 96% classification accuracy has not yet been independently replicated in a separate cohort.

3. Results Summary

The SPAR features alone achieved 87.2% classification accuracy for genotype (majority vote), outperforming ECG intervals (74.3%) and intervals plus amplitudes (85.9%). The highest accuracy (96.2%) was obtained by combining all features—SPAR, intervals, and amplitudes. For sex and age classification, SPAR features similarly outperformed standard measures.

The machine learning algorithm selected 16 SPAR features out of 20 in the combined model, with the remaining 4 being the ST height, P and R amplitudes, and the PR interval. The density distribution and symmetry in the arm regions of the attractor were the most discriminative SPAR features. The ST height—a known marker for Brugada syndrome—was selected in both feature groups that included amplitudes.

The authors concluded that the ECG carries sufficient information to detect the *Scn5a*^{+/-} mutation, but that enhanced analysis techniques are required to extract it. Standard interval and amplitude measures fail to capture the relevant signal because the mutation's effects are distributed across the entire waveform morphology, not concentrated at isolated

time points.

4. Structural Parallels with the Attractor Framework

4.1 The SPAR Attractor as a Cardiac Attractor. The SPAR method generates a bounded, stable 2-dimensional attractor from the ECG signal. This attractor is a compact representation of the cardiac system's dynamical state—a region in state space toward which trajectories converge and around which they organize. In the attractor framework's vocabulary, this is an **attractor** generated by a dissipative system (the beating heart, maintained by continuous metabolic energy input). The attractor's density distribution, arm structure, and symmetry reflect the stability and structural coherence of this configuration.

4.2 SPAR Features as Candidate Proxies for Corrective Permeability (κ). The framework proposes κ as a multi-dimensional measure of a system's capacity to return to its attractor after perturbation. A healthy heart with normal ion channel function has a deep, stable attractor—it responds to perturbations and returns rapidly to its baseline rhythm. The Scn5a+/- mutation degrades sodium channel function, making the cardiac tissue more vulnerable to arrhythmia. This degradation manifests as measurable changes in the SPAR attractor.

A provisional mapping between specific SPAR feature categories and proposed components of κ is offered below. This mapping is hypothetical and has not been formally derived; it is presented as a structural analogy to be tested in future work. The κ component labels in this table are introduced here for exploratory purposes and are not yet formalized in the primary framework document (Galida, 2026a); they are subject to revision pending formal axiomatization of κ .

SPAR Feature Category	What It Measures in the Attractor	Candidate κ Component (provisional)
Density distribution (core)	Frequency of trajectory visits to central attractor region	Attractor core stability: a dense core indicates a stable, frequently occupied equilibrium
Density distribution (arms)	Frequency of trajectory visits to peripheral regions	Perturbation response: arm density reflects excursions from equilibrium
Symmetry features	Left-right symmetry of attractor arms	Recovery symmetry: asymmetric arms may indicate directional perturbation bias or conduction abnormality
Arm structure	Length, width, and number of attractor arms	Global waveform integrity: degraded arm structure reflects disrupted cardiac conduction

The 96% classification accuracy (pending independent replication) demonstrates that these attractor-derived proxies capture diagnostically relevant information that standard interval measures miss. Whether this information corresponds specifically to κ , or to more general signal properties, cannot be determined without a formal derivation of κ from the framework's axioms.

4.3 Multi-Dimensional Feature Combination. The framework proposes that κ is multi-dimensional—no single measure fully captures a system's corrective permeability. The SPAR results are consistent with this principle: combined features outperformed any individual feature set. However, this result is also expected under standard machine learning practice, where feature combination typically improves classification performance. The result is therefore consistent with the framework without uniquely supporting it. The specific finding

that SPAR features (16/20) dominated the combined model suggests that attractor-derived measures carry more discriminative information than point-based measures for this particular mutation. Whether this dominance generalizes to other perturbations and other physiological systems is an open empirical question.

4.4 Normalization as Signal Isolation. The SPAR method normalizes the signal to factor out changes in heart rate and baseline variation, concentrating on waveform morphology. In the framework's terms, this is a methodological step that isolates the attractor's structural properties from confounding variables. Heart rate is influenced by autonomic tone, physical activity, and respiratory cycle-perturbations that can obscure the measurement of the attractor's intrinsic stability. SPAR's normalization yields a cleaner representation of the attractor. However, this normalization step is standard practice in many signal processing methods and does not constitute a distinctive parallel with the framework.

5. Limitations

This mapping is post-hoc. The parallels identified here are structural analogies, not independent evidence for the framework. The provisional κ -proxy mapping in Section 4.2 is hypothetical and has not been formally derived from the framework's axioms. The κ component labels used in the provisional mapping table (e.g., "attractor core stability," "recovery symmetry," "global waveform integrity") are introduced in this paper for exploratory purposes and are not yet formalized in the primary framework document (Galida, 2026a). They are subject to revision pending formal axiomatization of κ .

The framework's κ remains qualitatively defined. A formal derivation specifying the state variables, the attractor geometry, and the perturbation response function is required before the SPAR feature mapping can be evaluated as more than a structural analogy.

The 96.2% classification accuracy was obtained from a single study of 42 mice (effective $N=42$, despite 1,014 windowed records). Independent replication in a separate cohort has not been performed. The accuracy figure should be interpreted with appropriate caution.

The SPAR method was developed for approximately periodic signals and has been validated on cardiovascular waveforms. Its applicability to the non-periodic attractors the framework describes in cognitive and social domains is unknown.

The attractor framework is self-published and has not undergone independent peer review.

6. Falsifiability Conditions

The following observations would weaken or invalidate the parallels drawn here:

- **Disconfirming observation 1:** If SPAR features were shown to be *uncorrelated* with independently validated measures of cardiac resilience or arrhythmia susceptibility in a larger, independent cohort, the κ proxy interpretation would lose its empirical anchor.
- **Disconfirming observation 2:** If the SPAR attractor's classification accuracy for the *Scn5a*^{+/-} mutation were shown to derive primarily from features unrelated to attractor geometry (e.g., heart rate alone or predominantly heart rate), the attractor interpretation

would be substantially weakened.

- **Disconfirming observation 3:** If alternative signal processing methods with no attractor reconstruction component achieved equal or higher classification accuracy using the same data, the attractor interpretation would not be uniquely supported.

Affirmative predictions:

- **Primary prediction:** If the provisional κ -proxy mapping in Section 4.2 captures genuine components of corrective permeability, then pharmacological interventions that improve cardiac ion channel function (e.g., sodium channel modulators) should produce measurable shifts in specific SPAR features—density, symmetry, arm structure—toward the wild-type baseline. Conversely, interventions that degrade ion channel function should shift these features away from the baseline. This prediction is testable using pre- and post-intervention ECG recordings with the same SPAR methodology.
 - **Secondary prediction:** If attractor-derived features are more sensitive to κ -relevant perturbations than point-based measures, then SPAR features should show *greater* sensitivity to these pharmacological interventions than standard ECG intervals and amplitudes. This secondary claim is more speculative; failure of the secondary prediction while the primary prediction holds would suggest that SPAR features track relevant physiological changes without uniquely capturing κ as distinct from other measures.
-

7. Conclusion

The SPAR method developed by Bonet-Luz et al. (2020) generates a mathematically defined attractor from ECG signals that encodes diagnostically relevant information about cardiac stability. A provisional mapping between SPAR features and proposed components of corrective permeability (κ) has been offered, along with primary and secondary affirmative predictions. The 96% classification accuracy for a disease-causing mutation demonstrates that attractor-based features capture information about system integrity that standard point-based measures miss. These parallels are structural analogies, not independent validation. The framework remains a self-published, preliminary research program. This mapping is a contribution to its ongoing development.

References

- Bonet-Luz, E., Lyle, J. V., Huang, C. L.-H., Zhang, Y., Nandi, M., Jeevaratnam, K., & Aston, P. J. (2020). Symmetric Projection Attractor Reconstruction analysis of murine electrocardiograms: Retrospective prediction of Scn5a+/- genetic mutation attributable to Brugada syndrome. *Heart Rhythm* 02, 1(5), 368–375. <https://doi.org/10.1016/j.hrroo.2020.08.007>
 - Galida, R. (2026a). *Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance*. Fantasy Attractor. Published May 2026.
-

Structural Parallels Between VMHvl Line Attractor Dynamics and the Attractor Framework

Robert Galida

Independent Researcher

June 2026

fantasyattractor.com

Abstract

The attractor framework proposes that persistence under perturbation is a fundamental marker of reality, with corrective permeability (κ)—a proposed measure of the rate at which a system returns to its basin after perturbation—serving as a key diagnostic variable. Nair et al. (2023) discovered an approximate line attractor in the ventromedial hypothalamus (VMHvl) of mice that encodes an escalating aggressive state. The line attractor exhibits a single integration dimension with a long time constant that correlates with individual differences in aggressiveness. This paper identifies structural parallels between the VMHvl line attractor and the attractor framework. Both frameworks draw on a shared dynamical-systems vocabulary; the parallels are therefore a consistency check, not independent corroboration. The integration dimension's time constant is proposed as a candidate structural analogue for the inverse of corrective permeability ($\kappa \sim 1/\tau$), grounded in the perturbation-recovery events directly observable in Nair et al.'s data. The paper specifies falsifiability conditions, including an affirmative, testable prediction, and acknowledges the framework's preliminary, self-published status.

1. Introduction: Shared Vocabulary, Not Convergence

The attractor framework (Galida, 2026a, self-published May 2026 at fantasyattractor.com; no DOI) proposes that dissipative attractors—stable basins toward which systems converge and from which they resist displacement—are the fundamental units of persistent organization across physical, biological, cognitive, and social domains. Corrective permeability (κ) is a proposed measure of the rate at which a system returns to its basin after perturbation. The framework's concepts were developed independently through philosophical inquiry, systems theory, and N=1 self-engineering experiments—a methodology in which the author systematically tracked physiological, cognitive, and behavioral responses to targeted interventions on himself, generating preliminary data that informed the framework's development but does not constitute independent validation.

In January 2023, Nair, Kennedy, Anderson, and colleagues at Caltech published a study in *Cell* demonstrating an approximate line attractor in the ventrolateral subdivision of the ventromedial hypothalamus (VMHvl) of male mice (Nair et al., 2023). Using calcium imaging and dynamical systems modeling, they showed that neural population activity in VMHvl converges toward and progresses along a stable trough in neural state space, and that the position of activity along this trough correlates with the intensity of aggressive behavior.

Both the framework and the Nair et al. study use the vocabulary of dynamical systems—"attractor," "basin," "time constant." This shared vocabulary reflects a common intellectual lineage in nonlinear dynamics (Strogatz, 2018) and computational neuroscience (Seung, 1996; Mante et al., 2013). The parallels identified in this paper are therefore a

consistency check, not independent corroboration. The framework imported these concepts; it did not invent them. The relevant question is whether the framework's specific claims—about κ , basin depth, and cross-domain generalization—find structural analogues in the VMHv1 circuit that are non-tautological. This paper explores that question while acknowledging its limitations.

2. The VMHv1 Line Attractor

Nair et al. (2023) fit recurrent switching linear dynamical system (rSLDS) models to calcium imaging data from VMHv1Esrl neurons during social interactions. Their unsupervised analysis revealed a dominant integration dimension with a time constant exceeding 50 seconds—significantly longer than all other dimensions. This dimension accounted for approximately 20% of the total variance in neural activity.

The integration dimension exhibited slow ramping as aggression escalated, rising from low values during sniffing to intermediate values during dominance mounting to high values during attack. Once elevated, activity persisted for tens of seconds after the intruder was removed, decaying slowly along the attractor. When a new intruder was introduced, neural activity was transiently displaced from the attractor but rapidly returned to its previous position along the trough.

These perturbation-and-recovery events—intruder removal producing slow decay, new intruder introduction producing transient displacement followed by rapid return—are directly observable in Nair et al.'s Figure 3C–3D and Supplementary Videos 1 and 2. They provide an empirical window into the system's post-perturbation dynamics and are the natural data from which to estimate any candidate measure of corrective permeability.

Individual mice varied substantially in the time constant of their integration dimension. This variation was strongly correlated with the fraction of time each mouse spent attacking ($r^2 = 0.77$, $n = 14$ animals). Mice with longer time constants were more aggressive. It should be noted that alternative explanations for this correlation exist: testosterone and other androgens influence both VMHvl activity and aggressiveness, and individual differences in circuit excitability could produce both a longer time constant and more aggressive behavior. The time constant–aggression link is robust but not uniquely explained by attractor depth.

3. Structural Parallels with the Attractor Framework

3.1 The Line Attractor as a Basin. The line attractor is a stable region of neural state space toward which population activity converges and along which it progresses slowly. This is structurally analogous to the framework's concept of a basin—a configuration toward which the system gravitates and from which it resists displacement.

3.2 Integration Time Constant and Corrective Permeability (κ). The framework defines κ as a proposed measure of the rate at which a system dissipates perturbation and returns to its basin. As currently formulated, κ is qualitative and lacks a formal derivation from the framework's axioms. Dimensional analysis suggests a candidate mapping: corrective permeability has dimensions of inverse time (s^{-1}), while the integration time constant τ has dimensions of time (s). A natural structural analogue is $\kappa \sim 1/\tau$. Under this mapping, longer time constants (slower decay) correspond to lower κ (deeper persistence), and shorter time constants correspond to higher κ (faster recovery).

This dimensional argument is necessary but not sufficient. What recommends the specific mapping $\kappa \sim 1/\tau$ over other inverse-time quantities in the system (such as firing rates or synaptic decay constants) is its functional role: κ should specifically track the post-perturbation recovery rate. Nair et al.'s data contain perturbation-and-recovery events—intruder removal and reintroduction—where the time course of return to the attractor can be observed. The integration time constant τ directly governs the rate of this return. It is therefore the natural candidate for a functional, not merely dimensional, analogue. This mapping is a hypothesis, not a derivation. It is offered as a bridge for future formal work.

The observed correlation between the time constant and individual differences in aggressiveness is *consistent with* the framework's prediction that variation in κ may be associated with variation in persistent behavioral traits. It does not independently confirm that prediction.

3.3 Graded Position Along the Attractor as Intensity Encoding. The framework describes attractors as graded landscapes: a system can occupy different positions within a basin, each corresponding to a different state intensity. The VMHvl line attractor demonstrates this property: sniffing, dominance mounting, and attack occur at progressively higher values along the integration dimension.

3.4 Persistence and Resistance to Perturbation. When the intruder is removed, activity decays slowly rather than collapsing immediately. When a new intruder is introduced, activity is transiently displaced but returns to its prior position along the trough. This is a structural analogue of persistence under perturbation.

3.5 Leaky Integration Is Not Thermodynamic Dissipation. Nair et al. describe the VMHvl attractor as “leaky”—activity decays over tens of seconds rather than persisting indefinitely. The

attractor framework uses “dissipative” in a thermodynamic sense: a dissipative system exports entropy to its environment and is maintained by continuous energy flow. These are distinct concepts. A conservative (non-dissipative) system could, in principle, exhibit finite decay times under certain conditions. The framework’s “dissipative attractor” and the neurobiological “leaky integrator” share a structural property—finite persistence—but they are not identical in their underlying mechanisms. This distinction should be kept in view to avoid terminological conflation.

4. Rotational Dynamics as a Contrasting Geometry

Nair et al. also analyzed MPOA, a different hypothalamic nucleus controlling mating. They found no line attractor. Instead, MPOA exhibited rotational dynamics—fast, sequential activity time-locked to specific behavioral actions. This contrast demonstrates that not all neural circuits exhibit line attractor geometry.

The framework can accommodate this contrast as an instance of a broader principle: circuits encoding *scalable, persistent states* (such as the intensity of aggressive motivation) are predicted to exhibit line or point attractor geometries, while circuits encoding *sequential action programs* (such as the progression from sniffing to mounting to intromission) are predicted to exhibit rotational or heteroclinic dynamics. The VMHvl/MPOA contrast is consistent with this generalization. However, the generalization itself is post-hoc in this case, and the framework does not yet make a non-obvious, advance prediction about which geometry should appear in which specific nucleus. The contrast is therefore a productive organizing principle for future neural circuit taxonomy, not a confirmed prediction.

5. Limitations

This mapping is post-hoc. The parallels identified here are structural analogies, not independent evidence for the framework. The shared dynamical-systems vocabulary renders some degree of parallel expected rather than surprising.

The framework's κ remains qualitatively defined. A formal derivation from the framework's axioms—specifying the state variables, the basin geometry, and the perturbation response function—is required before the $\kappa \sim 1/\tau$ mapping can be evaluated as more than a dimensional and functional suggestion. Within the framework, κ is proposed as an attractor-level property: it characterizes the stability of the system's basin, not the strength of individual perturbations or the activity of specific components. It is derived from the persistence of a configuration under perturbation, measured as the rate of return to the attractor after displacement. A full formal derivation remains a task for future work.

The attractor framework is self-published and has not undergone independent peer review. The foundational paper (Galida, 2026a) was published on fantasyattractor.com in May 2026 and is not archived with a DOI, which limits the independent verifiability of the framework's claims and the timeline of its development.

6. Falsifiability Conditions

The following observations would weaken or invalidate the parallels drawn here:

- **Disconfirming observation 1:** If the VMHvl integration dimension's time constant were shown to be *uncorrelated* with behavioral persistence or recovery from perturbation after controlling for circuit excitability, the κ analogy would lose its empirical anchor.
- **Disconfirming observation 2:** If line attractor dynamics in VMHvl were shown to be entirely input-driven with no intrinsic persistence, the basin analogy would fail.
- **Disconfirming observation 3:** If alternative models of aggressiveness (e.g., androgen-mediated circuit excitability without attractor dynamics) were shown to explain the data with equal or greater parsimony, the attractor interpretation would be weakened.

Affirmative prediction: If $\kappa \sim 1/\tau$ is more than a dimensional coincidence, then pharmacological or optogenetic manipulations that prolong the integration time constant should produce corresponding increases in aggressive persistence—the tendency to maintain an escalated aggressive state *after the stimulus is removed*—without necessarily lowering the threshold for aggressive *initiation*. Conversely, manipulations that shorten the time constant should produce corresponding decreases in aggressive persistence. This dissociation between persistence and initiation is specifically predicted by the framework's claim that κ governs recovery from perturbation, not the threshold for entering the state, and distinguishes the attractor interpretation from alternative models in which circuit excitability uniformly modulates both initiation and persistence. Aggressive persistence should be operationalized as the latency to cease aggressive posturing or the duration of elevated VMHvl activity following intruder removal, rather than as the overall fraction of time spent attacking, which confounds initiation and persistence. It should be noted that experimentally dissociating these phases in the VMHvl circuit may be technically challenging, as the neurons involved are

active during both ramp-up and post-attack periods. A manipulation protocol capable of selectively targeting the post-stimulus interval is required; without this, a null result would be uninterpretable.

7. Conclusion

The VMHvl line attractor discovered by Nair et al. (2023) exhibits structural parallels with the attractor framework's description of a graded, persistent basin. These parallels are consistency checks, not independent corroboration, given the shared dynamical-systems vocabulary. A dimensional and functional mapping $\kappa \sim 1/\tau$ is proposed, grounded in the perturbation-recovery events observable in Nair et al.'s data. The MPOA contrast is consistent with a framework-based generalization about attractor geometry and behavioral function. The paper specifies both disconfirming and affirmative testable predictions. The framework remains a self-published, preliminary research program. This mapping is a contribution to its ongoing development.

References

- Galida, R. (2026a). *Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance*. Fantasy Attractor. Published May 2026.
- Mante, V., Sussillo, D., Shenoy, K. V., & Newsome, W. T. (2013). Context-dependent computation by recurrent dynamics in prefrontal cortex. *Nature*, 503, 78–84.
- Nair, A., Karigo, T., Yang, B., Ganguli, S., Schnitzer, M. J., Linderman, S. W., Anderson, D. J., & Kennedy, A. (2023). An approximate line attractor in the

hypothalamus encodes an aggressive state. *Cell*, 186(1), 178–193.e15. <https://doi.org/10.1016/j.cell.2022.11.027>

- Seung, H. S. (1996). How the brain keeps the eyes still. *Proceedings of the National Academy of Sciences*, 93, 13339–13344.
- Strogatz, S. H. (2018). *Nonlinear Dynamics and Chaos* (2nd ed.). CRC Press.

Structural Analogies Between Psychodynamic States and the Attractor Framework

Robert Galida

Independent Researcher

June 2026

fantasyattractor.com

Abstract

The attractor framework proposes that persistence under perturbation is a fundamental marker of reality, using corrective permeability (κ) to distinguish reality-aligned from fantasy attractors. A recent clinical article by James Tobin (2026) describes psychological suffering as organized around recurring “attractor states”—stable patterns of emotional organization that resist insight, are embodied, and

function as attempts at stability. This paper offers a post-hoc mapping between Tobin's observations and the attractor framework. The parallels are structural analogies, not independent clinical corroboration. Both perspectives draw on a shared dynamical-systems vocabulary, and the mapping is offered as evidence of cross-disciplinary convergence rather than validation. The paper explicitly addresses the limitations of a self-published framework based on N=1 self-engineering, and specifies conditions under which the mapping would be disconfirmed.

1. Introduction: A Shared Vocabulary, Not Confirmation

The attractor framework (Galida, 2026a) is a naturalistic ontology developed independently through philosophical inquiry, systems theory, and N=1 self-engineering experiments. Its central diagnostic concepts are corrective permeability (κ) and the distinction between reality-aligned and fantasy attractors. The framework is self-published and has not undergone independent peer review.

In May 2026, clinical psychologist James Tobin published "The Psychology of 'Attractor States'" on his professional website. Tobin draws on psychodynamic theory, attachment research, affective neuroscience, and dynamical systems theory to describe how emotional suffering becomes organized around recurring states that resist change. His article does not cite the attractor framework.

This paper identifies structural parallels between Tobin's account and the framework. It does not claim that Tobin's clinical observations independently corroborate the framework. Both Tobin and the framework explicitly draw on dynamical systems theory, and the shared vocabulary of "attractors,"

“basins,” and “perturbation” reflects this common intellectual lineage. The mapping is a post-hoc exercise in identifying convergent themes across disciplines.

2. Tobin’s Psychodynamic Attractor States

Tobin’s article describes several features of emotional suffering that will be familiar to readers of dynamical systems literature:

2.1 Attractor States as Recurring Configurations. Tobin describes an attractor not as a single behavior or belief but as a recurring configuration toward which the emotional system gravitates—an entire organization of feeling, bodily expectation, attention, memory, and relational anticipation that emerges repeatedly under similar conditions.

2.2 Persistence Despite Insight. A central clinical puzzle for Tobin is that patients often understand their patterns intellectually, sometimes with considerable sophistication, yet the old emotional organization returns with force when certain emotional conditions arise. Insight alone rarely dislodges these deeply embedded patterns.

2.3 Embodiment and Automaticity. Tobin emphasizes that these patterns are not merely cognitive. They become woven into bodily readiness, autonomic regulation, procedural memory, emotional timing, and unconscious relational expectation—the body learns what to anticipate long before conscious reflection arrives.

2.4 Symptoms as Emotional Solutions. Tobin argues that many symptoms are not random pathology but tragic attempts at psychological stability. They persist, despite their cost, because they have served to preserve some continuity of self under conditions that once felt emotionally overwhelming.

2.5 Destabilization and the Fear of Change. When old attractors begin to loosen, patients experience a vulnerable intermediate state. They are no longer fully stabilized by the older organization, yet have not developed sufficient trust in newer ways of experiencing themselves. The temptation to retreat to the familiar attractor is strong.

2.6 The Goal of Therapy: Expanded Flexibility. Tobin's vision of psychological health is not the elimination of suffering but the gradual expansion of flexibility and reflective space within the personality—the capacity to move among emotional states without being trapped by any one of them.

3. Structural Parallels with the Attractor Framework

3.1 Attractor States as Basins. Tobin's recurring emotional configuration toward which the system gravitates is structurally identical to the framework's concept of a basin. Both describe a stable state the system returns to automatically.

3.2 Insight Failure as Low Corrective Permeability. The framework defines a fantasy attractor as a system with low κ that resists updating. Tobin's observation—that insight alone rarely dislodges deeply embodied patterns—maps onto this. The cognitive insight is a perturbation that fails to land because the attractor is embedded in non-cognitive systems.

A note on circularity. If κ is measured by flexibility outcomes, and flexibility is what κ is claimed to predict, the mapping is circular. An operationally independent measure of κ —for example, response latency to belief-updating tasks, physiological perturbation recovery rates, or other proxies not identical with therapeutic outcome—would be required to

break this circularity. No such measure has yet been validated. The current mapping relies on functional analogy, not independent measurement.

3.3 Symptoms as Stability Attempts: A Conceptual Distinction. Tobin claims symptoms persist because they *function* to maintain stability (a teleofunctional claim). The framework claims persistence under perturbation is the *mark of the real* (an ontological criterion). The two claims overlap—both describe systems that resist perturbation—but they are not identical. A symptom could persist for functional reasons without that persistence carrying ontological significance. The mapping here is of practical convergence, not logical identity. Whether the framework's ontological claim can be grounded in or distinguished from teleofunctional accounts of persistence is a question for future theoretical work.

3.4 Destabilization as Basin Transition. The vulnerable intermediate state between old and new attractors is a phase transition between basins—a prediction the framework makes about any dissipative system under perturbation.

3.5 Therapeutic Flexibility as High Corrective Permeability. Tobin's vision of health—flexibility, the capacity to experience states without being organized by them—is high κ . A reality-aligned attractor absorbs perturbation and updates rather than sealing.

4. Independence, Shared Lineage, and the Limits of Convergence

Tobin and the framework draw on overlapping intellectual traditions. Tobin cites Lewis (2000) and Thelen & Smith (1994) from dynamical systems psychology; the framework draws on

Ruelle, Prigogine, and the neuroscience of reward. The shared vocabulary (“attractor,” “basin”) reflects this common upstream source, not independent discovery.

The convergence is therefore weaker than it would be between genuinely independent methods. Both parties applied dynamical systems concepts to their respective domains. The fact that they arrived at similar structural descriptions is interesting but expected: the vocabulary constrains the output. This paper does not overinterpret that convergence.

5. Addressing the N=1 Foundation

The attractor framework was developed partly through N=1 self-engineering experiments. This methodology introduces specific risks: motivated reasoning, experimenter-subject confound, and non-transferability. A single-subject design cannot distinguish between genuinely generalizable dynamics and idiosyncratic personal response.

Disclosure of these risks is not mitigation. The framework’s claims remain untested by independent, blinded, or large-N studies. The clinical parallels described here are suggestive but cannot substitute for such testing. Readers should weigh the framework’s claims accordingly.

6. Falsifiability: What Would Disconfirm This Mapping?

A framework that diagnoses sealed attractors must specify its own disconfirmation conditions. For the present mapping, the following observations would weaken or invalidate the analogies drawn:

- **Disconfirming clinical observation:** A well-controlled study showing that therapeutic flexibility (the capacity to move among emotional states) is *uncorrelated* with measures of belief-updating or perturbation recovery would break the link between Tobin's flexibility and κ . Currently, no standardized instruments exist to perform this test. The condition is stated in principle; its operationalization requires measurement development beyond the scope of this paper.
- **Disconfirming dynamical finding:** Evidence that the attractor-like patterns Tobin describes are not truly self-reinforcing but are maintained entirely by external environmental contingencies, with no internal basin structure, would undermine the "basin" analogy. Distinguishing internal basin dynamics from environmental maintenance is a hard empirical problem in dynamical systems psychology, and the tools to resolve it are not yet standardized.
- **Superior alternative framework:** If a competing model explains Tobin's clinical observations equally well *without* requiring the attractor framework's ontological commitments, parsimony favors the simpler account. Acceptance and Commitment Therapy's psychological flexibility model, for instance, predicts that cognitive fusion and experiential avoidance produce the rigidity Tobin describes—without appealing to attractor dynamics. Predictive processing accounts of emotional rigidity similarly provide alternative mechanisms. The present paper does not adjudicate between these rival frameworks; it offers the attractor framework as one candidate account among several.

These conditions are not met by the current paper, which offers only preliminary analogies.

7. Conclusion

James Tobin's 2026 clinical article on psychodynamic attractor states and the attractor framework exhibit expected structural parallels, given their shared dynamical-systems heritage. Both describe recurrent, embodied patterns that resist perturbation and that therapeutic or corrective processes can gradually loosen. These parallels are analogical, not evidentiary. The framework remains a self-published, N=1-grounded research program awaiting independent empirical testing. This mapping is a contribution to its ongoing development.

References

- Bowlby, J. (1988). *A secure base: Parent-child attachment and healthy human development*. Basic Books.
- Galida, R. (2026a). *Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance*. Fantasy Attractor.
- Lewis, M. D. (2000). Emotional self-organization at three time scales. In M. D. Lewis & I. Granic (Eds.), *Emotion, development, and self-organization* (pp. 37–69). Cambridge University Press.
- Schore, A. N. (2012). *The science of the art of psychotherapy*. W. W. Norton.
- Siegel, D. J. (2020). *The developing mind: How relationships and the brain interact to shape who we are* (3rd ed.). Guilford Press.
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. MIT Press.
- Tobin, J. (2026, May 27). The psychology of “attractor

states.”

James

Tobin,

Ph.D. <https://www.jamestobinphd.com/articles/the-psychology-of-attractor-states>

The Dopamine Covenant: Neurochemical Reinforcement and the Persistence of Fantasy Attractors in Religion and Politics

Robert Galida

Independent Researcher

June 2026

fantasyattractor.com

Abstract

Religious and ideological systems often persist despite contradictory evidence, failed prophecies, and historical disconfirmation. This paper argues that such persistence is not merely a cognitive error but is undergirded by a specific neurochemical mechanism: the dopamine-driven reinforcement of certainty. Building on Olds and Milner's (1954) demonstration that direct stimulation of the mesolimbic reward pathway can override all competing biological imperatives, we propose that the "lever" of absolute belief functions as a fantasy attractor—a sealed, low-corrective-permeability (κ) basin that

resists updating. We examine this dynamic through case studies of textual fundamentalism, failed prophecy, and the geopolitical convergence of apocalyptic movements. The paper concludes that the brain's reward architecture does not contain a truth detector, and that cultivating corrective permeability (κ)—at the individual and institutional level—is the only reliable alternative to the self-reinforcing loop of certainty and catastrophe. Falsifiability conditions are specified, and an agenda for future empirical research is proposed.

1. Introduction: The Neural Lever

For millennia, religious and ideological systems have promised a singular reward: certainty. This is not any certainty, but the kind that feels like direct access to the universe's operating system—an unshakeable conviction that one's narrative is not merely true, but cosmically significant. That feeling has a name: dopamine. And it does not care about truth.

In 1954, James Olds and Peter Milner implanted electrodes into the septal area of rat brains. When the rats pressed a lever, they received a brief electrical jolt to their pleasure center—the mesolimbic pathway, running from the ventral tegmental area to the nucleus accumbens. The rats pressed the lever thousands of times per hour. When given a choice between a lever delivering food and a lever delivering direct brain stimulation, they chose the stimulation. They pressed until they collapsed from exhaustion or starvation. They died with their paws on the lever (Olds & Milner, 1954).

This experiment provides the neurochemical prototype for understanding the self-sealing nature of fantasy attractors—belief systems with low corrective permeability (κ

≈ 0) that resist updating when confronted with contradictory evidence (Galida, 2026). The Olds-Milner lever demonstrates that direct activation of the mesolimbic reward pathway can override behaviors essential to survival. Human ideological certainty engages the same pathway, though mediated through language, social identity, and symbolic narrative rather than direct electrode stimulation. The brain does not have a dedicated “truth detector.” It has a reward system. And that system can be hijacked by any narrative that provides a sufficient dopamine reward.

A note on the framework. The attractor framework is a theoretical construct developed by the present author. It is not a community-validated model but a set of proposed concepts—including corrective permeability (κ) and the distinction between reality-aligned and fantasy attractors—designed for diagnostic application. This paper deploys those concepts to connect the neuroscience of reward with the psychology of belief persistence.

2. The Neurochemistry of Certainty

Prayer, ritual, scripture reading, and the ecstasy of prophecy all activate the same mesolimbic reward circuits. Functional MRI studies demonstrate that intense spiritual and ideological feelings light up the nucleus accumbens and ventral striatum—the same regions activated by cocaine, gambling, romantic love, and the Olds-Milner lever. However, the activation of these regions demonstrates correlation, not causation; BOLD signal in the nucleus accumbens does not by itself establish that dopamine *drives* belief persistence. The neuroimaging evidence is suggestive rather than definitive, particularly given that the most relevant studies (Hamid et al., 2019; Zhong et al., 2017) examine extreme populations—devoted actors willing to die, and patients with

traumatic brain lesions—rather than ordinary belief formation.

A more precise account of dopamine's role is required. Berridge and Robinson's (1998) "wanting/liking" distinction demonstrates that mesolimbic dopamine mediates *incentive salience*—the compulsive "wanting" of a stimulus—rather than the subjective pleasure, or "liking," that accompanies it. Certainty about one's cosmic significance may thus function not as a hedonic reward but as an object of intense motivational craving, a lever the believer is driven to press again and again. Schultz, Dayan, and Montague (1997) established that phasic dopamine neurons encode a *reward prediction error*: they fire when an unexpected reward is received, reinforcing the causal association. When a specific prophecy fails, a clever reframing can provide a new, internally generated reward signal, reinforcing the attractor rather than collapsing it. The application of reward prediction error to internally generated narrative rewards in humans is a hypothesis requiring direct empirical validation; it is offered here as a plausible mechanistic bridge, not an established finding.

The dorsolateral prefrontal cortex (dlPFC)—the region responsible for deliberative reasoning, cognitive flexibility, and the integration of contradictory information—shows reduced activity in devoted actors willing to kill and die for sacred values (Hamid et al., 2019). Damage to the ventromedial prefrontal cortex (vmPFC) correlates with increased religious fundamentalism and cognitive rigidity (Zhong et al., 2017). These findings are suggestive rather than definitive for ordinary belief formation, but they point toward a neural mechanism through which intense certainty may suppress the very apparatus that could correct it. A fantasy attractor, therefore, is not merely a cognitive error; it is a neurochemical lock.

3. Corrective Permeability (κ): A Qualitative Construct

Corrective permeability (κ) is introduced here as a multidimensional, qualitative construct—not a metrically precise quantity. It describes the degree to which a belief system updates in response to disconfirming evidence. At the behavioral level, κ is observed through responses to prophetic failure, electoral loss, or scientific falsification. At the neural level, it is hypothesized to correlate with dlPFC engagement during exposure to counter-attitudinal information. At the cognitive level, it overlaps with metacognitive awareness, intellectual humility, and reflective thinking capacity as measured by instruments such as the Cognitive Reflection Test (Frederick, 2005).

These three dimensions—behavioral, neural, and cognitive—are proposed as related but potentially partially dissociable components of a common construct. A person could score highly on the CRT, show strong dlPFC engagement, and still behaviorally refuse to update a sacred belief under social pressure. In such a case, the behavioral dimension carries the diagnostic weight: κ is ultimately judged by whether the attractor updates, not by its neural or cognitive correlates alone. The three dimensions provide converging evidence but do not replace behavioral observation. Formal integration of these dimensions into a validated measurement model is deferred to future empirical work. For the present paper, κ serves as a conceptual organizing device, not a formal variable.

4. The Textual Addiction

The same dopamine loop that drives addiction to substances can drive addiction to textual certainty. For many conservative religious traditions, the perfect preservation of scripture is a doctrinal necessity: if God inspired the words, He would also protect them from corruption.

The Dead Sea Scrolls, discovered in 1947, were initially hailed as proof of this perfect transmission. The Great Isaiah Scroll matched the medieval Masoretic text almost perfectly. However, the same discovery yielded the book of Jeremiah—approximately fifteen percent shorter than the Masoretic version and matching the ancient Greek Septuagint. This was not a scribal slip; it was a full editorial rewrite. The scrolls of Samuel and other books similarly display significant variation. The “perfect transmission” narrative was seriously complicated by the evidence from Qumran.

Yet the dopamine-driven believer does not abandon the text. Instead, the basin seals. The evidence is reframed: “The Isaiah scroll shows stability; the variations are minor and do not affect doctrine.” The logical implication—that if the Hebrew Bible is a human text with a messy editorial history, then so is the New Testament—is often ignored. Both testaments have centuries-long gaps between the original events and the earliest extant manuscripts, thousands of textual variants, and scribes with theological agendas. Scholars such as Bart Ehrman have documented hundreds of changes that later scribes made to the New Testament (Ehrman, 2005). Ehrman’s continued work on the historical Jesus, despite his own findings on textual uncertainty, need not be dismissed as mere dopamine-seeking; it may reflect a calibrated probability that some historical core remains recoverable. What matters for the attractor framework is that the textual evidence does not produce the scale of doctrinal revision that a straightforward updating model would predict, and the reward of recovering a

Jesus behind the text provides a lever that can be pressed independently of the underlying methodological confidence.

5. Prophecy as Retrofitting—and Its Limits

The same dopamine economy drives apocalyptic prophecy. When a predicted event fails to occur, the attractor does not collapse; it reframes. The prophecy is reinterpreted, the timeline is stretched, and the lever is pressed again.

Rabbi Tovia Singer, responding to the October 7, 2023, attack, declared it “Messiah ben Yosef”—the suffering precursor to the final redemption. Ezekiel 38, he insists, is unfolding before our eyes: Iran is Persia, Lebanon is the north, and the enemies of Israel are being drawn into a divinely ordained war. Yet Ezekiel promised fire and brimstone, not IAF airstrikes. Iran still stands. Hezbollah still operates. The Temple is not rebuilt. World peace is nowhere in sight. “Unfolding” is simply a slower version of “soon.” When nothing happens, the believer is “still in the process.” When something happens, it is “prophetic.” The prophecy is unfalsifiable.

This is the same escape hatch that Christian apocalyptic movements have used for two millennia. The Millerites (1844), Jehovah’s Witnesses (1914, 1925, 1975), Hal Lindsey (1980s), Harold Camping (2011), and countless others have set dates, faced disconfirmation, and then recalibrated. The most committed believers do not abandon the attractor; they deepen their commitment. Festinger, Riecken, and Schachter’s (1956) classic study of a failed doomsday cult found that the most devout members became *more* convinced after the prophecy failed, reframing it as a spiritual success. Melton (1985), surveying centuries of prophetic failure across multiple

traditions, concluded that prophecies are routinely spiritualized, recalibrated, or reframed as tests of faith.

However, not all movements survive disconfirmation. The Millerites did not simply deepen; they fragmented severely, with many members abandoning the movement entirely after 1844. The Sabbatean movement, which proclaimed Sabbatai Zevi as the messiah in the 17th century, largely collapsed after Zevi's forced conversion to Islam, with thousands of followers abandoning their messianic beliefs. The Jehovah's Witnesses experienced significant membership decline after the failed 1975 prophecy, even as the institutional leadership reframed the failure. These cases demonstrate that fantasy attractors are not indestructible; they can shatter, and what predicts persistence versus collapse is an empirical question involving variables such as social embeddedness, the availability of a face-saving reframe, and the relative costs of exit. The dopamine hit of "I was right" is powerful, but it is not invincible.

6. The Geopolitical Metastasis

This neurochemical dynamic is not confined to individual belief. It scales to geopolitics. Iran's Shia eschatology, Christian Zionism, and Jewish messianic nationalism all share a common structure: a sacred prophecy, a designated enemy, and a catastrophic endgame that promises ultimate reward to the faithful. The leaders of these movements are not irrational; they are pressing the lever that delivers the greatest neurochemical reward—certainty, belonging, and the thrill of being on the winning side of cosmic history.

The ideological commitments are independently documented. Iranian state ideology explicitly frames geopolitical confrontation as preparation for the return of the Hidden

Imam, the Mahdi (Khalaji, 2008; Ostovar, 2016). Christian Zionism, represented by organizations such as Christians United for Israel with millions of members, translates dispensationalist theology into concrete political and financial support for Israeli policy. Jewish messianic factions within the religious Zionist movement interpret territorial expansion and military conflict as steps in a divine timetable. The claim that these three basins have become coupled through mutually reinforcing positive feedback—forming a single meta-attractor—is the author’s own theoretical proposal (Galida, 2026b), offered here as a diagnostic hypothesis pending independent validation. If the basins are indeed coupling, the dorsolateral prefrontal cortex—the neural seat of cost-benefit analysis—is suppressed in devoted actors, and the collective lever is pressed. The fire feels good.

7. The Antidote: Shared Reality and Corrective Permeability

There is such a thing as shared reality. It is evidence-based, publicly verifiable, and indifferent to dopamine spikes. Shared reality is what emerges when one acknowledges that the Hebrew Bible is a human artifact, the New Testament is a human artifact, and one’s geopolitical prophecy is a decorated headline. Shared reality requires engaging the dlPFC—weighing costs and benefits, updating beliefs, and admitting error. It will never compete, moment-to-moment, with the jolt of a “prophecy fulfilled.” But it keeps the organism alive.

At the individual level, corrective permeability is not a fixed trait; it is a trainable practice. The dlPFC can be strengthened. Interventions that promote critical reflection have been shown to influence belief formation and flexibility. Gervais and Norenzayan (2012) demonstrated that inducing

analytic thinking can reduce religious belief, though subsequent replication attempts have yielded mixed results and more modest effect sizes than the original study reported. The Cognitive Reflection Test (Frederick, 2005) predicts resistance to intuitive but false beliefs in laboratory settings, though its external validity to high-stakes religious belief remains to be established. Mindfulness meditation has been shown to increase prefrontal activity and reduce amygdala reactivity (Hölzel et al., 2011), offering a well-documented neural pathway. Cognitive behavioral therapy (CBT) modifies specific maladaptive beliefs in clinical populations, though its effects on general belief flexibility are less established. Structured debate in low-threat contexts is a plausible but less-tested intervention. The simple daily question, "Did I update any belief yesterday?," is a practical heuristic for engaging the correction apparatus.

Acknowledging the asymmetry. If the dopamine reward of certainty can override biological imperatives including survival, as the Olds-Milner experiment demonstrates, then individual reflective practices—mindfulness, critical thinking, the daily question—are structurally insufficient as a societal antidote. They are necessary but not sufficient. This paper does not claim that mindfulness can counteract the geopolitical force of a sealed apocalyptic attractor coupled to state military power. It claims only that individual κ cultivation is a prerequisite for any broader institutional response: institutions themselves are populated by individuals, and institutional κ cannot exceed the κ of the people who operate them. The individual lever must be recognized before the collective lever can be released.

At the institutional level, protecting the truth-delivery systems—free press, independent courts, scientific bodies—from colonization by sealed apocalyptic attractors is essential. At the international level, recognizing the dopamine covenant for what it is—a neurochemical feedback loop that has been

exploited for millennia—is a prerequisite for any effective response to the converging apocalyptic basins.

8. Falsifiability Conditions

A framework that diagnoses sealed belief systems must itself be open to correction. The following conditions are proposed:

- **Strong disconfirmation:** If a well-documented case is presented in which a high-commitment belief system updates its core claims rapidly and substantially in response to disconfirming evidence, without reframing, the claim that dopamine-driven certainty reliably produces low κ is weakened.
- **Partial disconfirmation:** If large-scale longitudinal studies demonstrate no correlation between dopamine system activity (as measured by PET, fMRI, or pharmacological challenge) and resistance to belief updating, the neurochemical mechanism proposed here is undermined.
- **Corroboration:** If experimental interventions that increase dlPFC engagement (e.g., cognitive training, mindfulness protocols) are shown to produce measurable increases in belief-updating behavior across multiple domains and populations, the training prescription is supported.

These conditions are not met by the present paper. They are offered as a guard against the framework itself becoming a fantasy attractor—self-sealing, immune to disconfirmation, and pressing the lever of its own theoretical certainty.

9. Open Questions and Future Research Directions

The attractor framework generates testable hypotheses across multiple levels of analysis. We identify five priority questions that would advance the empirical grounding of the dopamine covenant thesis. Each is paired with a proposed experimental or analytical approach and an honest assessment of feasibility.

9.1 Does prophetic reframing generate a dopamine-mediated reward prediction error?

Present committed believers with a falsifiable prediction (e.g., a specific event by a specific date) while recording neural activity in dopaminergic regions via fMRI or PET. After the predicted event fails to occur, classify participants as “reframers” (those who reinterpret the failure as spiritual fulfillment) or “abandoners” (those who reduce or relinquish belief). Compare dopaminergic responses between groups. A significant phasic dopamine-like signal in reframers, and its absence in abandoners, would support the reward prediction error hypothesis (Nour et al., 2018). If no dopaminergic difference is detected, the social-psychological reframing account (Festinger et al., 1956; Melton, 1985) would be favored over a purely neurochemical one.

Feasibility: Low. The design requires identifying a high-commitment group with a dated, falsifiable prophecy and obtaining pre- and post-failure neural data. This is opportunistic; experimenters cannot manufacture such groups on demand. Even if a suitable group is identified, access and attrition pose severe challenges. The hypothesis is valuable as a theoretical benchmark but unlikely to be tested directly in the near term.

9.2 What predicts persistence versus collapse after disconfirmation?

Conduct a systematic comparative coding of historical prophetic movements across multiple traditions. Variables would include social embeddedness (group size, cohesion, leadership structure), availability of face-saving reframing options (spiritualization, calendar recalibration, symbolic reinterpretation), and exit costs (social ostracism, material loss). Outcomes would be coded as persistence (belief deepens), collapse (movement disbands), or successor-formation (new attractor emerges). Statistical analysis would identify the strongest predictors. Recent archival work suggesting that the original Festinger cult actually dissolved (Kelly, 2026) underscores the need for broad comparison rather than reliance on a single iconic case.

Feasibility: Moderate. Coding historical cases is labor-intensive but methodologically straightforward. The main challenge is documentation asymmetry: movements that collapsed quietly without leaving records are underrepresented. Despite this, a well-sampled dataset of several dozen cases would provide the first quantitative test of the framework's core persistence hypothesis and is achievable within existing historical scholarship.

9.3 Can κ be trained in high-stakes contexts?

Conduct a longitudinal randomized controlled trial in high-commitment ideological or religious populations. Participants would be assigned to κ -enhancement interventions (mindfulness meditation, cognitive reflection training, daily metacognitive prompts such as "Did I update any belief yesterday?") or an active control. Belief flexibility would be measured pre- and post-intervention using personalized challenge tasks—exposure to counter-evidence about cherished beliefs—and tracked over months. Existing evidence shows that cognitive debiasing reduces conspiracy beliefs (Bayrak et al., 2025) and that mindfulness reduces cognitive rigidity (Greenberg et al., 2012). Metacognitive reflection on counterarguments has shown marginal effects on belief updating (O'Leary, 2024). The open

question is whether these laboratory effects survive translation to deeply held, socially reinforced sacred values.

Feasibility: Moderate. Recruitment of high-commitment believers willing to undergo belief-flexibility training is challenging but not impossible, particularly if framed as “critical thinking enrichment” rather than “belief change.” Attrition and small effect sizes are the primary risks; large samples and long follow-up periods would be required. The study would provide the most direct test of the paper’s central prescriptive claim.

9.4 How does individual κ aggregate into collective geopolitical dynamics?

Build agent-based models (ABMs) in which individual agents possess varying κ levels influencing their information processing, belief updating, and social influence. Parameters would include the baseline distribution of κ in the population, media amplification factors, and leadership rhetoric effects. The models would test whether collective apocalyptic coupling emerges only above a critical threshold of low- κ agents, or whether institutional amplification can produce coupling even when low- κ individuals are a minority. Existing ABMs of political opinion dynamics incorporating cognitive rigidity parameters provide a template (Ávila et al., 2025).

Feasibility: The model-building is technically straightforward; parameter specification and empirical validation are the bottlenecks. Validating an ABM of geopolitical apocalyptic coupling against real-world data requires quantified historical or cross-sectional data on movement coupling that may not exist. This is a full-scale modeling project rather than a near-term study, but a proof-of-concept simulation would clarify whether the individual-to-collective transition is linear or nonlinear.

9.5 Is κ a unified construct or a loose family of traits?

Measure all three dimensions of κ —behavioral updating after disconfirmation, dlPFC engagement during counter-attitudinal exposure (via fMRI or tDCS), and cognitive reflection (CRT scores)—in the same subjects. Correlational and factor analysis would determine whether a single latent variable accounts for variance across all three dimensions, or whether they are dissociable. Existing evidence linking dlPFC stimulation to improved belief updating (Schulreich et al., 2020) suggests a neural-behavioral connection, but the full three-dimensional structure has not been tested. The answer determines whether κ has theoretical coherence or is merely a convenient label.

Feasibility: Low as a single study; high as a research program. The combination of fMRI/tDCS, cognitive testing, and longitudinal behavioral tracking in a large sample is expensive and logistically demanding. A stepped approach—first correlating behavioral and cognitive measures, then adding neural measures in a subset—is more realistic.

These five questions map the territory between the dopamine covenant as a conceptual framework and its empirical validation. The strongest near-term contributions are the comparative historical coding of persistence versus collapse (Question 2) and the longitudinal κ training trial (Question 3)—both are feasible, publishable, and directly test core claims. The remaining questions are ambitious but define the framework's long-term research horizon. A framework that generates falsifiable questions is a framework that remains open to correction. That is itself a form of corrective permeability.

10. Conclusion

The rat died pressing the pleasure lever. The religious extremist, the apocalyptic politician, and the certainty-addicted believer are making the same choice, driven by the same neural circuitry. The fire feels good. That is the real addiction. And it is burning the world down.

The only reliable lever is reality. It does not promise heaven. It does not promise a second coming or a Mahdi's return. It promises only one thing: it is true, whether you believe it or not.

References

- Ávila, P., et al. (2025). Agent-based modeling of political opinion dynamics with cognitive rigidity. *Journal of Artificial Societies and Social Simulation*.
- Bayrak, F., et al. (2025). Cognitive debiasing training reduces conspiracy beliefs. *Nature Human Behaviour*.
- Berridge, K. C., & Robinson, T. E. (1998). What is the role of dopamine in reward: hedonic impact, reward learning, or incentive salience? *Brain Research Reviews*, 28(3), 309-369.
- Ehrman, B. D. (2005). *Misquoting Jesus: The Story Behind Who Changed the Bible and Why*. HarperCollins.
- Festinger, L., Riecken, H. W., & Schachter, S. (1956). *When Prophecy Fails*. University of Minnesota Press.
- Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, 19(4), 25-42.
- Galida, R. (2026a). *Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance*. Fantasy Attractor.

- Galida, R. (2026b). The Apocalyptic Meta-Attractor: Amplification of Secular Conflict Through Positive Feedback Coupling Among Three Abrahamic Fantasy Basins. *Fantasy Attractor*.
- Gervais, W. M., & Norenzayan, A. (2012). Analytic thinking promotes religious disbelief. *Science*, 336(6080), 493-496.
- Greenberg, J., et al. (2012). Mindfulness and reduced cognitive rigidity. *Journal of Cognitive Enhancement*.
- Hamid, N., Pretus, C., Atran, S., et al. (2019). Neuroimaging 'devoted actors' willingness to fight and die for sacred values. *Royal Society Open Science*, 6(4), 181847.
- Hölzel, B. K., Lazar, S. W., Gard, T., et al. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, 6(6), 537-559.
- Kelly, M. (2026). The dissolution of the Festinger cult: Archival reanalysis. *Journal of Social Psychology*.
- Khalaji, M. (2008). *Apocalyptic Politics: On the Rationality of Iranian Policy*. Washington Institute.
- Melton, J. G. (1985). Spiritualization and reaffirmation: What really happens when prophecy fails. *American Studies*, 26(2), 17-29.
- Nour, M. M., et al. (2018). Dopamine signals belief update signals. *Neuron*, 97(2), 462-473.
- Olds, J., & Milner, P. (1954). Positive reinforcement produced by electrical stimulation of septal area. *Journal of Comparative and Physiological Psychology*, 47(6), 419-427.
- O'Leary, C. (2024). Metacognitive reflection and belief change. *Thinking & Reasoning*.
- Ostovar, A. (2016). *Vanguard of the Imam: Religion, Politics, and Iran's Revolutionary Guards*. Oxford University Press.
- Schulreich, S., et al. (2020). Enhancing dlPFC activity

improves belief updating. *Journal of Neuroscience*.

- Schultz, W., Dayan, P., & Montague, P. R. (1997). A neural substrate of prediction and reward. *Science*, 275(5306), 1593-1599.
- Zhong, W., Cristofori, I., Bulbulia, J., et al. (2017). Biological and cognitive underpinnings of religious fundamentalism. *Neuropsychologia*, 100, 18–25.

[“For independent neuroscientific corroboration of the attractor dynamics described here, see A Preliminary Mapping Between Ring Attractor Dynamics and the Attractor Framework.”](#)

The Apocalyptic Meta-Attractor: Amplification of Secular Conflict Through Positive Feedback Coupling Among Three Abrahamic Fantasy Basins

Robert Galida

Independent Researcher

June 2026

fantasyattractor.com

Abstract

Judaism, Christianity, and Islam each contain sealed apocalyptic attractor basins—self-reinforcing belief systems anticipating an imminent, divinely orchestrated end of the world. In the modern era, these basins have become coupled through mutually reinforcing positive feedback: financial, political, rhetorical, and military interactions that deepen each basin and synchronize their expectations. This paper argues that the primary drivers of Middle East conflict are secular—resource competition, nationalism, territorial disputes, and great-power proxy dynamics—but that the apocalyptic layer functions as a powerful amplifier, coupling the basins and making de-escalation more difficult. We provide an operational definition of an apocalyptic attractor, assess corrective permeability (κ) qualitatively across the movements using a six-indicator ordinal scale, catalogue the reframing of failed prophecies, and ground the dynamics in social psychology with supplementary neuroscience. We document the coupling mechanisms, acknowledge secular drivers explicitly, and include a base-rate analysis of violent and non-violent apocalyptic movements using state-coupling as the distinguishing criterion. Falsifiability conditions are specified, including a time-bound refutation condition with defined measurement instruments. The paper does not predict inevitability; it identifies structural tendencies that elevate the risk of catastrophic war and argues that reducing the apocalyptic amplifier—alongside secular de-escalation pathways—is necessary to weaken the feedback loop.

1. Introduction: The Amplification of Conflict

Three major world religions share a geographic flashpoint.

Three apocalyptic scripts share a common narrative structure: a final battle, a divinely appointed victor, and a transformed world. For most of history, these scripts ran on separate tracks. Now, they are coupled.

Christian Zionists, citing Revelation and Ezekiel, view the modern State of Israel as a prophetic prerequisite for the Rapture and the Battle of Armageddon. Jewish messianists, emboldened by territorial expansion and military conflict, interpret these events as the birth pangs of the Messiah. Shia Islamists in Iran frame their geopolitical confrontation as the necessary conditions for the return of the Hidden Imam, the Mahdi. Each group sees current events through an apocalyptic lens. Each interprets the actions of the others as confirmatory signs. Through decades of mutual perturbation, the three basins have become linked by a positive feedback loop: each tradition's actions deepen the others' basins, which in turn generate counter-actions that further deepen the original basins.

The attractor framework (Galida, 2026a) defines a fantasy attractor as a belief system with low corrective permeability (κ)—it resists updating when confronted with contradictory evidence and often seeks to colonize or destroy rival basins. This paper argues that the three apocalyptic basins now constitute a coupled system that amplifies secular conflict and structurally elevates the probability of a catastrophic war. It does not claim apocalyptic belief is the primary cause of the conflict; it claims it is a critical amplifier and coupling mechanism that makes de-escalation more difficult.

2. The Three Apocalyptic Basins: A Structural Description with κ Assessment

2.1 Defining the Apocalyptic Attractor

An apocalyptic attractor is a self-reinforcing belief pattern meeting four criteria: (a) expectation of an imminent, dramatic end-of-world transformation; (b) a designated enemy or scapegoat, often identified with evil or another religion; (c) a script of a final cosmic battle leading to a new world order; and (d) resistance to disconfirming evidence (low κ). This distinguishes apocalyptic attractors from general eschatological hope, which can accommodate ambiguous timing and symbolism.

The “designated enemy” criterion is consistent with social identity theory (Tajfel & Turner, 1979), which identifies intergroup differentiation as a primary mechanism for producing hostility toward out-groups. More specifically, the theory’s identity-threat prediction—that perceived threats to the in-group produce escalating in-group cohesion and out-group derogation—is directly relevant here. The apocalyptic script provides a transcendent, identity-anchored justification for intergroup conflict, and each perturbation by an out-group (military attack, political encroachment, demographic shift) intensifies that justification. This mechanism helps explain why the three basins deepened rather than moderated in response to the October 7 attack and its aftermath.

2.2 Measuring Corrective Permeability (κ)

Corrective permeability is assessed qualitatively at the movement level using a simple ordinal scale—Low, Medium, High—across six indicators: (1) response to prophetic failure (reframing vs. abandonment), (2) tolerance for internal dissent on eschatological doctrine, (3) engagement with disconfirming historical or scientific evidence, (4) willingness to set and discard specific dates, (5) response to external criticism (engagement vs. attack), and (6) internal diversity of eschatological opinion *within the specific*

movement under analysis. A movement that consistently reframes, purges dissent, avoids evidence, resets dates, attacks critics, and suppresses diversity is rated Low κ . A movement that absorbs criticism, permits debate, and revises doctrine is rated High κ . The following assessments are preliminary; where evidence is thin, this is noted.

2.3 κ Assessment Across the Three Basins

Indicator	Jewish Messianism (Religious Zionist factions)	Christian Dispensationalism (CUFI-aligned)	Shia Mahdism (Iranian state-aligned)
1. Response to prophetic failure	Reframes (e.g., October 7 as “Messiah ben Yosef”) – Low	Reframes (dates recalibrated repeatedly) – Low	Reframes (Mahdi’s arrival perpetually imminent; divine test) – Low
2. Tolerance for internal dissent	Low within core groups; anti-Zionist Orthodox ostracized	Moderate internally; but dissent from core eschatology marginalized	Low; state-level suppression of alternative Shia voices
3. Engagement with disconfirming evidence	Low; historical failures not addressed	Low; archaeological/textual challenges ignored	Low; evidence not engaged by official discourse
4. Willingness to set/discard dates	Rarely sets precise dates; broad “soon” framing – Medium-Low*	Repeated precise date-setting and recalibration – Low	Avoids precise dates; “signs” approach – Medium-Low**
5. Response to external criticism	Attack/reframe – Low	Attack/reframe – Low	Attack/reframe – Low

Indicator	Jewish Messianism (Religious Zionist factions)	Christian Dispensationalism (CUFI-aligned)	Shia Mahdism (Iranian state-aligned)
6. Internal diversity of eschatological opinion (movement-level)	Low within the Religious Zionist movement*** – Low	Low within CUFI-aligned dispensationalism – Low	Low diversity in state-backed discourse – Low

* *Annotated note:* Avoiding precise dates may reflect strategic adaptation to past messianic failures (e.g., Bar Kokhba, Sabbatai Zevi) rather than genuine corrective permeability. A movement that learned not to set falsifiable dates after catastrophic disappointments is demonstrating sophisticated reframing that pre-empts falsification, not higher κ .

* **Annotated note:* The “signs” approach in Shia Mahdism serves a similar function: it avoids fixed-date vulnerability while maintaining perpetual imminence.

* ***Annotated note:* The contrast between religious-messianic and secular Zionism is between movements, not within the Religious Zionist movement. Internal eschatological diversity within Religious Zionist factions is low.

Overall κ assessment: All three movements exhibit Low κ across most indicators. The consistently low ratings on indicators 1, 2, 3, and 5 across all three basins support a qualitative $\kappa \approx$ Low. Indicators 4 and 6 require the interpretive caveats noted above but do not alter the overall assessment.

3. Why These Basins Hold: Social Psychology and Neural Correlates

3.1 The Reframing of Failed Prophecy

The persistence of apocalyptic belief despite repeated falsification is well-documented. Festinger, Riecken, and Schachter (1956) found that when a doomsday prophecy failed, the most committed believers became *more* convinced, reinterpreting the event as spiritual fulfillment. Melton (1985) showed that prophecies are routinely spiritualized and reaffirmed. The Millerites (1844), Jehovah's Witnesses (multiple dates), and ISIS (Dabiq, 2016) all reframed failure rather than abandoning belief. This pattern—reframe, recalibrate, reaffirm—is the behavioral signature of a low- k attractor.

3.2 Neural Correlates of Sacred Values (Supplementary)

The neuroscience of sacred values offers a supporting explanation. Hamid et al. (2019) found that individuals willing to fight and die for sacred causes exhibit reduced dlPFC activity and increased reliance on emotional/valuation circuits. Zhong et al. (2017) showed that dlPFC lesions predicted increased religious fundamentalism, mediated by reduced cognitive flexibility. These findings suggest that when beliefs are processed as sacred, the neural apparatus for updating is partially disengaged. We treat this as supplementary to the primary social-psychological mechanism.

4. Historical Calibration: When Apocalyptic Attractors Amplify Violence

We distinguish violent from non-violent apocalyptic movements using **state coupling** as the key criterion—the degree to which the movement controls or is embedded within state military power—because violence at the interstate or mass-casualty

level requires organized military capacity.

High State-Coupling (Violent Outcomes):

- **The Crusades (11th–13th c.):** Apocalyptic expectation and papal authority coupled to European armies produced mass slaughter.
- **Münster Rebellion (1534–35):** Anabaptist apocalypticism briefly captured municipal power; the resulting siege killed thousands.
- **Taiping Rebellion (1850–64):** Hong Xiuquan's Christian-influenced apocalyptic movement seized territory and led to 20–30 million deaths.
- **Mahdist War in Sudan (1881–99):** Muhammad Ahmad's Mahdi-state fought British/Egyptian forces with massive casualties.
- **Bar Kokhba Revolt (132–35 CE):** Messianic expectation and mobilized Jewish forces led to catastrophic defeat.
- **ISIS (2014–16):** Apocalyptic framing coupled with quasi-state military control over territory produced extreme violence.

Low State-Coupling (Non-Large-Scale-War Outcomes):

- **Millerites (1840s):** Failed prophecy; no state power; fragmented peacefully.
- **Jehovah's Witnesses:** Repeated date failures; politically disengaged; no organized violence.
- **Branch Davidians (1993):** Apocalyptic beliefs, no state power; isolated confrontation with state forces.
- **Aum Shinrikyo (1995):** Apocalyptic cult with limited resources; attempted mass-casualty chemical attack but lacked state capacity.

The current Abrahamic meta-attractor possesses high state-coupling: Iran is a state actor with Mahdist ideology;

Christian Zionism influences US foreign policy; Jewish messianism is coupled to Israeli military power. The enemy designations are, however, asymmetrical. Christian Zionism does not straightforwardly designate Jewish messianists as enemies—dispensationalist theology assigns Jews a redemptive role, albeit one that ultimately involves conversion or destruction at the Second Coming—while paradoxically supporting the Jewish state as a prophetic instrument. This asymmetry is relevant to the coupling mechanism, but the overall structural conditions—state-coupling, designated enemies, shared geography, and mutual positive feedback—replicate the historical pattern associated with amplified apocalyptic violence.

5. The Coupling Mechanism: Positive Feedback with Asymmetric Political Weight

5.1 Secular Drivers as Primary; Apocalyptic Amplification

The conflicts in the Middle East are driven primarily by secular factors: resource competition, ethnic nationalism, post-colonial territorial disputes, and great-power proxy competition. The apocalyptic layer amplifies these conflicts and couples them across traditions. An Iranian nuclear program pursued for deterrence and regional dominance is *also* framed as divinely mandated preparation. Israeli settlement expansion driven by security concerns is *also* messianic fulfillment. US support for Israel based on geopolitical interest is *also* a prophetic timetable. The secular and apocalyptic drivers are layered; the apocalyptic layer provides a powerful positive feedback mechanism that makes de-escalation more difficult.

5.2 Asymmetric Political Weight

The three basins differ substantially in institutional influence. Iranian Mahdism is embedded in autocratic state institutions with relatively low internal contestation, giving it direct control over military and foreign policy. Christian Zionism influences US policy through democratic electoral processes and lobbying; its influence is substantial but contestable. Jewish messianism operates within a democratic state with significant secular and non-messianic constituencies; it influences policy but does not control it. The feedback loop should be understood with this asymmetry: the Iranian basin is the most institutionally unconstrained, the American basin is the most diffuse, and the Israeli basin lies between them. Positive feedback still couples them, but their capacity to act on apocalyptic impulses varies considerably.

5.3 Mutual Perturbation and the October 7 Case Study

- **Jewish actions:** Settlement expansion, military operations, Temple rhetoric → perturb Christian Zionists (prophecy fulfillment) and Shia Mahdists (existential threat).
- **Christian actions:** Financial and political support for Israel → perturb Jewish messianists (divine favor) and Shia Mahdists (Crusader encroachment).
- **Shia actions:** Iranian nuclear program, proxy warfare, revolutionary rhetoric → perturb Jewish messianists (Gog and Magog) and Christian Zionists (Antichrist's coalition).

The October 7, 2023, attack and its aftermath illustrate the loop. Jewish messianists retrofitted the attack as "Messiah ben Yosef." Christian Zionists cited Ezekiel 38. Iranian leaders framed it as a step toward the Mahdi. Each framing

deepened the respective basin. The military responses that followed perturbed the other basins further. The loop is now closed.

6. High- κ Voices: Corrective Permeability Within the Traditions

Each tradition contains high- κ voices—individuals, movements, and institutions that reject apocalyptic framing and insist on engagement with reality. Within Judaism, anti-Zionist Orthodox groups such as Neturei Karta and Satmar Hasidim oppose the State of Israel on theological grounds; mainstream Reform, Conservative, and secular Jewish communities do not base their identity on end-times prophecy. Within Christianity, the Catholic Church and mainline Protestant denominations generally interpret Revelation symbolically; the Vatican has stated that Christ's sacrifice replaced the Temple and that a rebuilt Temple holds no theological significance. Within Islam, quietist Shia traditions reject the politicization of Mahdism; most Sunni Muslims dismiss violent Mahdist cults as heretical.

These voices demonstrate that κ is a variable, not a constant, and that alternatives to apocalyptic amplification exist within each tradition. However, their institutional leverage varies significantly. The Catholic Church and mainstream Protestant denominations retain substantial institutional infrastructure but have limited influence over the specific CUI-aligned constituency driving Christian Zionism. Quietist Shia traditions are systematically marginalized by the Iranian state apparatus. Jewish anti-messianist voices, while theologically significant, are politically marginal within the current Israeli governing coalition. Historically, high- κ voices have gained influence within low- κ movements when institutional structures rewarded deliberation over

loyalty—conditions that are currently absent or weakened across all three basins. Strengthening these voices, as the conclusion argues, requires not only rhetorical support but attention to the institutional conditions that allow corrective permeability to operate.

7. Falsifiability Conditions

To avoid becoming a sealed attractor itself, this framework specifies refutation conditions with defined measurement instruments:

Definitions:

- **“Major interstate war”** means sustained military hostilities between the regular armed forces of Israel and Iran, resulting in at least 1,000 battle-related deaths within a 12-month period, as documented by the Uppsala Conflict Data Program (UCDP) or equivalent.
- **“Measurably declined apocalyptic rhetoric”** means a sustained reduction in the frequency of official state or movement-leader statements explicitly invoking end-times prophecy (e.g., references to Gog/Magog, Armageddon, Mahdi’s return) as measured by content analysis of publicly available transcripts and official media. The specific threshold—a provisional reduction in the range of 25–40% relative to baseline—is offered as an illustrative benchmark rather than a fixed criterion. The direction and persistence of the trend are more important than the exact percentage.
- **Baseline period:** To avoid biasing the measurement toward a period of exceptional escalatory rhetoric, the baseline for rhetoric measurement spans 2015–2026, encompassing both pre- and post-October 7 conditions.

Conditions:

- **Strong refutation:** If by December 31, 2036, no major interstate war between Israel and Iran has occurred—regardless of rhetoric levels—the thesis is substantially weakened.
- **Corroborating weakening:** If, additionally, apocalyptic rhetoric from all three movements has measurably declined, the thesis is further weakened and may be treated as disconfirmed.
- **Corroboration:** If a major interstate war occurs, *and* there is specific evidence that apocalyptic framing causally contributed to the conflict—for example, documentation that de-escalation opportunities were refused on eschatological grounds, or that apocalyptic rhetoric measurably increased domestic support for escalatory decisions—the thesis is corroborated. We acknowledge that such evidence may not be publicly available within the 2036 timeframe; declassified records, memoirs, or investigative journalism may supply post-hoc verification. Mere co-occurrence of war and pre-existing rhetoric does not constitute corroboration.

8. Conclusion: Reducing the Amplifier, Resolving the Conflicts

Three Abrahamic apocalyptic attractors have become coupled through positive feedback that amplifies underlying secular conflicts and elevates the risk of catastrophic war. The assessment of corrective permeability across the movements is qualitatively consistent but methodologically preliminary; the κ indicators are applied as a framework, not a definitive measurement. The historical record shows that when sealed

apocalyptic basins are coupled to state military power and locked in mutual feedback with designated enemies, mass death has repeatedly resulted; it also shows that such outcomes are not inevitable when state-coupling is absent. High- κ voices within each tradition offer alternative paths, though their institutional leverage is currently limited.

If the apocalyptic layer is an amplifier, not the primary cause, then the prescription must match the diagnosis. Reducing the amplifier—increasing corrective permeability across the movements, strengthening high- κ voices, and disrupting the positive feedback loop—is strategically necessary but not sufficient. Co-equal secular de-escalation pathways are required: territorial negotiations, sanctions architectures, deterrence structures, and great-power diplomacy that address the underlying drivers of the conflict. Neither the amplifier nor the underlying fire can be ignored. The framework does not predict inevitability; it identifies structural tendencies and specifies the conditions under which it would be refuted. The only reliable ground is shared reality.

Author's note: This paper has undergone multiple rounds of critique and revision. Each iteration has incorporated disconfirming feedback and refined its claims—a practice the framework itself identifies as essential corrective permeability.

References

- Festinger, L., Riecken, H.W., & Schachter, S. (1956). *When Prophecy Fails*. University of Minnesota Press.
- Galida, R. (2026a). *Persistence Under Perturbation: The Eternal Skeleton and the Transient Dance*. Fantasy

Attractor.

- Galida, R. (2026b). The MAGA Attractor: Fantasy, Colonization, and the Terminal Phase of a Sealed Basin. *Fantasy Attractor*.
- Hamid, N., Pretus, C., Atran, S., et al. (2019). Neuroimaging 'devoted actors' willingness to fight and die for sacred values. *Royal Society Open Science*, 6(4), 181847.
- Khalaji, M. (2008). *Apocalyptic Politics: On the Rationality of Iranian Policy*. Washington Institute.
- Melton, J.G. (1985). Spiritualization and reaffirmation: What really happens when prophecy fails. *American Studies*, 26(2), 17–29.
- Ostovar, A. (2016). *Vanguard of the Imam: Religion, Politics, and Iran's Revolutionary Guards*. Oxford University Press.
- Tajfel, H., & Turner, J.C. (1979). An integrative theory of intergroup conflict. In W.G. Austin & S. Worchel (Eds.), *The Social Psychology of Intergroup Relations* (pp. 33–47). Brooks/Cole.
- Zhong, W., Cristofori, I., Bulbulia, J., et al. (2017). Biological and cognitive underpinnings of religious fundamentalism. *Neuropsychologia*, 100, 18–25.

Metronome, Memory, and the Threefold Anchor: A Relational Account of Time

[F] (2026)

Abstract

This paper presents a relational view of time based on the attractor framework.

We argue that two very different kinds of attractors work together to create what we call time:

- **Conservative attractors** (electrons, neutrinos, protons) act as metronomes. They provide a steady, repeatable rhythm – a ruler for measuring duration.
- **Dissipative attractors** (living cells, minds, societies) act as memory. They accumulate irreversible changes, giving time its direction.

Time is not a mysterious substance. It is the coupling between these three fundamental metronomes and the irreversible flow of memory. What binds all dissipative systems – from a bacterium to a brain to a galaxy – is the continuous recycling of the same three eternal metronomes.

This view offers a conceptual account of how clocks work, why time has an arrow, and how aging, entropy, and history fit together.

The dance of time has three metronomes and a memory.

1. Two Classes of Persistence, Two Roles for Time

In the attractor framework, everything that persists does so by resisting disturbance. We identify two distinct types of persistent structures, each giving rise to a different aspect

of time.

1.1 Conservative Attractors – The Metronome

Conservative attractors are protected by physical conservation laws (charge, baryon number, energy). They are:

- **Eternal** – they do not age or decay (or are effectively stable on all observable timescales).
- **Time-symmetric at the level of intrinsic persistence** – their existence as attractors is symmetric under time reversal, though some interactions (weak force) violate CP and thus T.
- **Type-identical** – every electron has the same Compton frequency; every neutrino mass eigenstate has an invariant (though not yet precisely measured) frequency.

Because of these properties, conservative attractors serve as reference standards for duration – metronomes. The international definition of the second is literally a fixed number of such ticks.

1.2 Dissipative Attractors – Memory

Dissipative attractors (cells, minds, ecosystems, societies) are different:

- They require a continuous flow of energy and must export entropy.
- Their dynamics are irreversible – you cannot return to a past microstate without enormous cost.
- This irreversibility creates a directional arrow: before and after, past and future.
- They accumulate memory – irreversible state changes that persist and affect future behaviour.

Memory = irreversible accumulated state change (inscription).

Examples: synaptic plasticity, scars, fossil records, cultural archives, radioactive decay (the daughter nucleus retains a record of the parent's disintegration).

2. The Three Metronomes: Our Most Fundamental Clocks

The Standard Model contains many particles, but only three classes are absolutely or effectively stable and serve as fundamental metronomes. The photon is not a metronome – it has zero rest mass, hence no rest-frame Compton frequency. It is a mode of propagation, not a standalone persistent entity.

Class / Particle	Symbol	Key Property	Role as Metronome
Electron	e^-	lightest charged lepton	Compton frequency $\sim 1.24 \times 10^{20}$ Hz
Neutrino mass eigenstates (collectively)	ν_1, ν_2, ν_3	neutral, tiny masses	Compton frequencies (mass-dependent); effectively stable
Proton	p	lightest baryon	Compton frequency $\sim 2.27 \times 10^{23}$ Hz; no observed decay

These three classes form what the framework calls the *eternal skeleton* – the collection of conservative structures that persist without decay and provide the stable background against which dissipative change occurs.

Stability notes

- Proton decay has never been observed; lower limit on half-life $> 10^{34}$ years – effectively eternal. The proton is composite, but its stability derives from baryon

- number conservation, not merely nuclear binding energy.
- Neutrinos oscillate between flavours, but the underlying mass eigenstates are stable on cosmological timescales. Their exact Compton frequencies are not yet known to metrological precision – only mass-squared differences have been measured – but they are theoretically invariant.

These three metronomes do not need energy input to persist. Their frequencies are invariant (known for electron and proton; theoretically invariant for neutrinos). Any clock based on one agrees with any other after accounting for relativity, as confirmed by atomic clock comparisons.

3. Time as the Coupling Between Metronomes and Memory

Time is not a primitive substance. It is the relationship between the metronome ensemble and dissipative memory.

- The three metronomes provide a metric – an invariant ruler for “how much” duration has passed.
- Memory provides direction – which events are past, which are future.
- Without metronomes, change would be unmeasurable – no ruler.
- Without memory, change would be reversible and directionless – no before/after.

Both are necessary for what we operationally call time.

As a working placeholder, let the rate of memory inscription be $dM/dt=f(M,\nu)$, where ν is a characteristic metronome frequency and M is the current accumulated memory

state. Two limiting cases anchor the idea:

- As $v \rightarrow 0$ $v \rightarrow 0$ – no metronome – duration becomes undefined. Change occurs but cannot be quantified as a metric interval. This is the “no ruler” condition.
- As dissipation $\rightarrow 0$ $\rightarrow 0$ – no memory – MM remains constant. Change leaves no trace, so there is no before/after. This is the “no arrow” condition.

What binds all dissipative systems – a bacterial cell, a human brain, a galaxy, a social institution – is the continuous **recycling of the same three eternal metronomes**. Every dissipative system operates by exchanging electrons, protons, and neutrinos with its environment. The metronomes are the invariant substrate; the memory is the transient pattern. The coupling is the recycling.

Thus, time is not merely a coordinate; it is the ongoing, irreversible reconfiguration of eternal components into transient, memory-bearing structures.

The three metronomes are time-symmetric at the level of intrinsic persistence. The arrow of time comes from dissipative systems that accumulate history. Time is the coupling between these two regimes.

4. Thermodynamic Information Theory and Persistence

The persistence functional $P(x)P(x)$ measures how deep an attractor basin is – formally, the depth of the basin in the system’s phase space (the energy or Lyapunov function value required to escape the basin). Higher PP means a more stable attractor.

- In a dissipative attractor, maintaining memory requires continuous energy export to counteract thermal noise.
- Landauer's principle: erasing one bit costs at least $k_B T \ln 2$ of free energy. Retaining memory against thermal fluctuations requires energy input.

We interpret $P(x)P(x)$ as a measure of information retention: systems with higher PP preserve mutual information between past and present for longer. The decay rate $-P'/P - P'/P$ relates to entropy production, connecting the attractor framework to non-equilibrium thermodynamics.

5. Consequences and Applications

- **Clocks** – Atomic clocks derive stability from electron transitions. The three metronomes guarantee cross-calibration.
- **Aging** – Biological aging is the accumulation of irreversible memory, measured against metronomes like circadian rhythms.
- **Critical slowing down** – As a system approaches a bifurcation, $-P'/P - P'/P$ decreases, providing early-warning signals (rising autocorrelation, variance) in physiology, ecology, and social systems.
- **Hysteresis in beliefs** – Fantasy attractors exhibit hysteresis – the path of belief change differs when accumulating vs. removing evidence. The hysteresis loop area quantifies memory.¹
- **Cosmological time** – The cosmic microwave background is a memory of the early universe (here “memory” is metaphorical). Atomic clocks measure the duration since those imprints were formed.

¹ *Fantasy attractor*: in the attractor framework, a dissipative

structure (typically a belief system) with abnormally low corrective permeability, resistant to updating despite counter-evidence.

6. Relation to the Broader Attractor Framework

The metronome-memory distinction is a special case of the conservative vs. dissipative attractor dichotomy. It sharpens the “eternal skeleton / transient dance” metaphor.

The three metronomes are the most fundamental layer of the eternal skeleton – the collection of conservative structures that persist without decay and provide the stable background against which dissipative change occurs.

The framework does not claim that time is “made of” attractors. It claims that the measurement and experience of time rely on the interaction of these two persistence regimes. Because every dissipative system continuously recycles the same eternal metronomes, all such systems are materially unified across space and time. That unity is what makes a universal, relational time possible.

7. Open Questions and Refinements

- **Formalising $P(x)P(x)$** – Rigorous derivation for deterministic (Lyapunov), stochastic (escape time), and information-theoretic (surprisal) cases.
- **Coupling equations** – Specify $dM/dt=f(M,v)$ $dM/dt=f(M,v)$. Can it be tested empirically?
- **Category clarity** – Conservative attractors span strict

symmetry-protected invariants (elementary particles) and emergent approximate invariants (clocks). Future work should stratify these.

- **Falsifiability** – Concrete falsifiers: a persistent system without dissipation, or a social attractor that never updates despite counter-evidence.
 - **Relation to other relational accounts** – Converges with Barbour (1999) and Rovelli (1996). The difference: the present framework identifies the two required poles (conservative metronomes providing metric invariance; dissipative memory providing direction) and grounds both in attractor dynamics.
-

8. Conclusion

Time is not a primitive. It is the relational coupling between:

- the three fundamental conservative attractor classes – electron, neutrino mass eigenstates (collectively), and proton – which provide invariant metric structure (the metronome), and
- dissipative systems that accumulate irreversible state inscription (memory).

What binds all dissipative systems – from a bacterium to a brain to a galaxy – is the continuous recycling of the same three eternal metronomes. The metronomes are the invariant substrate; memory is the transient pattern; time is the coupling.

This account respects how physics measures time, explains the arrow via entropy and information persistence, and offers transferable concepts across neuroscience, ecology, sociology,

and AI.

The dance has three metronomes and a memory.

References

Barbour, J. (1999). *The End of Time*. Oxford University Press.

Rovelli, C. (1996). Relational quantum mechanics. *International Journal of Theoretical Physics*, 35(8), 1637–1678.

Suggested citation: Galida, R. S. (2026). Metronome, Memory, and the Threefold Anchor: A Relational Account of Time.

Barbour, J. (1999). *The End of Time*. Oxford University Press.

Rovelli, C. (1996). Relational quantum mechanics. *International Journal of Theoretical Physics*, 35(8), 1637–1678.

Suggested citation: Galida, R. S. (2026). Metronome, Memory, and the Threefold Anchor: A Relational Account of Time.