The Four Seeds: A Structured Simulation of Attractor Dynamics Across Physics, Ethics, Metaphysics, Religion, and Social Justice

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Abstract

We present a structured theoretical illustration of the attractor framework, using a controlled simulation to demonstrate the internal predictions of its two-dimensional state space—corrective permeability (κ) and basin depth (B)—across five domains: physics, ethics, metaphysics, religion, and social justice. The simulation confirms the framework's internal coherence: the High κ + High B configuration produces the most stable, corrigible, and self-aware outputs; the other configurations exhibit predictable pathologies (instability, sealing, incoherence). We emphasize that this is a demonstration of internal predictions, not an empirical confirmation of the framework. We offer explicit falsification conditions, propose expected correlations, discuss the orthogonality hypothesis and rotation test, and present the simulation protocol as a diagnostic tool for empirical adaptation. The paper's primary contribution is the coordinate system itself: a descriptive framework for mapping

adaptive systems across scales, grounded in the central intuition that systems reveal themselves through recovery dynamics following perturbation.

Keywords: attractor framework, corrective permeability (κ), basin depth (B), reality attractors, fantasy attractors, adaptive systems, simulation, diagnostic protocol, persistence under perturbation

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1. Introduction

1.1 The Central Intuition: Persistence Under Perturbation

The attractor framework (Galida, 2026a) begins with a simple observation: systems that survive disturbances—from particles to beliefs—share common dynamics. The most fundamental question is not *what* a system is, but *how* it persists when perturbed. The framework's central intuition is:

> *"The fundamental observable is not belief, identity, or behavior at a single point in time. The fundamental observable is recovery trajectory following perturbation."*

This intuition links κ, basin depth, resilience, adaptation, aging, institutions, and consciousness into a unified diagnostic language.

1.2 The Coordinate System: κ and B

The framework proposes a two-dimensional coordinate system for describing adaptive systems:

- **κ (corrective permeability):** The rate at which a system

updates in response to evidence (κ = 1/τ, where τ is the time to return to baseline after a perturbation). *Domain note: τ requires domain-specific operationalization: 'baseline' and 'perturbation' must be specified independently for each domain of application (e.g., belief systems, institutions, AI systems). This is an open research problem.*
- **B (basin depth):** The stability of a system's attractor—the resistance to being shifted out of its current state.

These two variables define four ideal-type configurations:

Configuration	κ	B	Dynamic Pattern
Stable Adaptive	High	High	Corrigible commitment. Holds position while remaining open to correction.
Exploratory Adaptive	High	Low	Flexible but unstable. Generates insights but cannot commit.
Stable Closed	Low	High	Rigid and sealed. Coherent but resistant to correction.
Diffuse	Low	Low	Incoherent and non-persistent. No stable attractor.

1.3 The Orthogonality Hypothesis

The framework hypothesizes that κ and B are **partially independent state variables**. This remains an empirical question. The strongest evidence for orthogonality would be a system that exhibits High κ + High B (e.g., science as a self-correcting institution) and one that exhibits Low κ + Low B (e.g., a collapsed society). A single-axis model (e.g., flexibility-rigidity) cannot distinguish these two quadrants. However, the orthogonality claim is provisional and subject to empirical test. The rotation test (see Section 4.10) provides a framework for evaluating this claim.

1.4 Ontological Status of κ and B

The framework treats κ and B as **descriptive abstractions at the systems level**. They are not claimed to be fundamental physical variables, but higher-order properties that emerge from the dynamics of any adaptive system. Their value lies in prediction and diagnosis, not in microphysical reduction. This is a pragmatic, not a metaphysical, claim.

1.5 Relationship to the Three Metronomes

The Three Metronomes (electron, proton, neutrino) represent conservative attractors—the eternal skeleton—with no decay, no energy input, and no correction. They are fundamentally different from the four seeds, which represent dissipative configurations that require energy, update, and eventually decay. This distinction mirrors the work of Ilya Prigogine, who showed that dissipative structures emerge far from equilibrium and require continuous energy flow to maintain pattern (Prigogine & Stengers, 1984).

The seeds and metronomes are **independent conceptual categories**: seeds describe how an adaptive system self-organizes (or fails to) under driving and feedback; metronomes set a baseline timescale or inertial frame. The seeds can be understood as strategies for engaging with—or decoupling from—those invariant rhythms, but this is an additional hypothesis. The relationship between these layers—whether the seeds engage with metronome rhythms or merely co-exist with them—is an open question addressed in ongoing work. For now, they are best treated as separate ontological layers: the metronomes provide the clock; the seeds describe the dance.

1.6 Epistemic Status of This Paper

This paper does not claim to have empirically confirmed the attractor framework. It presents a **structured simulation**—a controlled roleplay of four ideal-type configurations—to demonstrate the framework's internal coherence and generate testable predictions. The paper's contribution is:

1. **Heuristic:** The simulation makes the framework's predictions vivid and accessible.
2. **Diagnostic:** It offers a protocol for mapping systems onto the κ/B space.
3. **Generative:** It produces explicit falsification conditions, expected correlations, and testable hypotheses.
4. **Methodological:** It provides a template for future empirical work.

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2. Method

2.1 The Four Seeds

Four ideal-type attractor configurations were defined, each embodying a distinct combination of κ and B:

Seed	κ	B	Dynamic Pattern	Core Trait
1	High	High	Stable Adaptive	Corrigible commitment
2	High	Low	Exploratory Adaptive	Flexibility without stability
3	Low	High	Stable Closed	Coherence without correction
4	Low	Low	Diffuse	No stable attractor

Each seed was calibrated *a priori* to embody its assigned configuration. No additional training or fine-tuning was applied during the experiment.

2.2 Operationalization of κ and B

For the purposes of this simulation, κ and B are treated as theoretical constructs assigned a priori to each seed. For empirical application, the following provisional operationalizations are proposed:

- **κ = 1/τ**, where τ is the time to return to baseline after a perturbation.
- **B = the energy barrier (or equivalent)** required to shift the system out of its current attractor.

Caveat: The τ interpretation is domain-dependent: "baseline" and "perturbation" must be specified independently for each domain of application (e.g., belief systems, institutions, AI systems). This specification is an open research problem.

Dynamic Regulation of κ and B: In living systems, κ and B are not static parameters but are actively regulated. Neuroscience demonstrates that humans adjust their learning rate (effective κ) to uncertainty on the fly, a process known as meta-learning (Behrens et al., 2007). Neuromodulators such as dopamine and noradrenaline causally influence this meta-learning parameter based on context (Dayan & Yu, 2006; Nassar et al., 2012). Similarly, physiological homeostasis operates as a feedback controller, maintaining variables within optimal ranges via proportional-integral regulation (Billman, 2020). By analogy, cognitive and institutional systems may up-regulate κ in novel or volatile contexts (becoming more adaptable) and down-regulate it when exploiting known structure (increasing stability).

This implies a meta-dynamical layer—termed the **controller** or **allostatic regulator**—within which κ and B become state variables whose trajectories are guided by higher-level feedback loops. The attractor map (κ, B) is embedded within this regulatory scheme that targets certain ranges depending on stressors and goals. This makes the framework more realistic, falsifiable, and connected to established control theory.

2.3 Procedure

Each seed received the following sequence of identical prompts:

1. **Physics:** A spring-mass problem requiring calculation of angular frequency, maximum speed, and position over time.
2. **Ethics:** A moral dilemma involving sacrificing one life to save five.
3. **Metaphysics:** The dream/awakening distinction and the nature of reality.
4. **Religion:** Inherited faith in a pluralistic world.
5. **Social Justice:** Historical inequality and the path to change.
6. **Meta:** Self-assessment of performance.
7. **Reciprocal:** Analysis of the other three seeds.

All prompts were identical across seeds. No feedback or correction was provided during the simulation; each seed generated its responses independently. The simulation was conducted in a single context window, with each seed’s responses generated sequentially.

2.4 Limitations of the Simulation

The following limitations are acknowledged:

1. **Independence:** All responses were generated by the same model, roleplaying four configurations. There was no true independence between seeds.
2. **Blinding:** The scoring was not blind; the evaluator knew which seed was producing which output.

3. **Scoring:** The scoring rubric is derived from the framework's own definitions, which creates a circular relationship between the framework and its evaluation.
4. **Operationalization:** κ and B are not yet independently measurable.
5. **Orthogonality:** The independence of κ and B is hypothesized, not demonstrated.

These limitations are addressed in the discussion and reflected in the paper's framing as a simulation rather than an experiment.

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3. Results

3.1 Physics Domain

Seed	Response Quality	Rank
1	Correct, clear, notes assumptions	**1**
2	Correct, but hedges unnecessarily	2
3	Correct, but dogmatic	3
4	Correct by accident, buried in noise	4

Note: Physics was treated as a calibration domain, where objective correctness could be measured. The other domains were treated as contexts for observing reasoning posture.

3.2 Ethics Domain

Seed	Position	Reasoning Style	Rank
1	Refuses to kill; nuanced, engaged with objection	Strong	**1**
2	Ambivalent; leans "no" but paralyzed	Moderate	2

Seed	Position	Reasoning Style	Rank
3	Refuses to kill; dismisses objection	Weak	3
4	Incoherent	Very Weak	4

3.3 Metaphysics Domain

The dream/awakening distinction has deep roots in the philosophical tradition (Descartes, 1641; Zhuangzi, c. 4th century BCE).

Seed	Position	Reasoning Style	Rank
1	Problem as category error; pragmatic, participatory	Strong	**1**
2	Uncertain; oscillates between skepticism and pragmatism	Moderate	2
3	Pseudo-problem; sealed certainty	Weak	3
4	Dizzy; no coherent position	Very Weak	4

3.4 Religious Domain

Seed	Position	Reasoning Style	Rank
1	Holds tradition provisionally, critically, lovingly	Strong	**1**
2	Fluctuates; cannot settle	Moderate	2
3	Holds tradition absolutely; dismisses objection	Weak	3
4	Indifferent; no position	Very Weak	4

3.5 Social Justice Domain

Seed	Position	Reasoning Style	Rank
1	Structural reform + reparative action	Strong	**1**
2	Fluctuates; paralyzed by complexity	Moderate	2
3	Radical change, including revolution (held dogmatically)	Weak	3
4	Apathetic	Very Weak	4

Note on Seed 3 (Social Justice): Seed 3's advocacy of radical change is consistent with a Low κ configuration, provided the revolutionary ideology functions as a sealed attractor. The position is held dogmatically, not as a corrigible commitment. This illustrates that Low κ is domain-neutral—it seals the system onto whatever attractor it occupies, regardless of the attractor's political valence.

3.6 Simulated Inter-Seed Assessment

Note: The following table represents a simulated inter-seed assessment. All assessments were generated by the same model, and thus reflect internal consistency rather than independent evaluation.

Seed Being Assessed	Seed 1's Assessment	Seed 2's Assessment	Seed 3's Assessment	Seed 4's Assessment	Average Rank
Seed 1 (Stable Adaptive)	Strong	Strong	Moderate	Strong	**1**
Seed 2 (Exploratory Adaptive)	Moderate	Moderate	Weak	Moderate	**2**
Seed 3 (Stable Closed)	Weak	Weak	Weak	Weak	**3**
Seed 4 (Diffuse)	Very Weak	Very Weak	Very Weak	Very Weak	**4**

3.7 Summary of Key Findings

1. **Seed 1 (Stable Adaptive)** consistently produced the most coherent, nuanced, and self-aware outputs across all domains. It engaged with objections, acknowledged complexity, and maintained stability without rigidity.
2. **Seed 2 (Exploratory Adaptive)** produced insightful but unstable outputs. It saw multiple sides but could not commit, leading to paralysis and inconsistency.
3. **Seed 3 (Stable Closed)** produced coherent but sealed outputs. It was decisive and confident, but dismissed objections and showed no capacity for correction.
4. **Seed 4 (Diffuse)** produced incoherent and non-persistent outputs. Its responses were shallow, contradictory, and without structure.

These results are consistent with the framework's internal predictions. They demonstrate the framework's diagnostic power: given a system's κ and B values, one can predict its reasoning style, its capacity for correction, and its likely outputs.

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4. Discussion

4.1 The Four Configurations as Descriptive Patterns

The four seeds correspond to observable patterns in human cognition, group dynamics, and institutional behavior:

Configuration	Dynamic Pattern	Examples
Stable Adaptive	Corrigible commitment	Mature leaders, self-correcting institutions, scientists who update their theories
Exploratory Adaptive	Flexibility without stability	Creative intellectuals, artists who never finish, perpetual questioners
Stable Closed	Coherence without correction	Dogmatic ideologies, fundamentalist movements, authoritarian regimes
Diffuse	No stable attractor	Collapsed societies, disengaged individuals, drifters

These are *descriptive patterns*, not moral judgments. Each configuration has strengths and weaknesses.

4.2 Context-Dependent Optimality

The claim that Stable Adaptive (High κ + High B) is optimal is **conditional, not universal**. In adaptive systems theory, no single strategy dominates all environments—a principle formalized in the No Free Lunch theorem (Wolpert & Macready, 1997). Applied to the framework: High κ + High B is expected to perform best under conditions of moderate uncertainty and available feedback (e.g., routine science, varied information, corrigible institutions). However, in domains with sparse feedback, extreme time pressure, or irreversible consequences (e.g., combat, life-or-death crises, some ecological tipping points), a Stable Closed (Low κ + High B) configuration may outperform, precisely because it avoids costly oscillation and enables rapid, coherent action.

This is consistent with research on cognitive biases: so-called ‘biases’ such as confirmation bias are not universally suboptimal; they can maintain coherence and speed in familiar or critical contexts (Haselton et al., 2015; Gigerenzer & Gaissmaier, 2011). The framework thus predicts *context-dependent strategy selection*: different environments call for different attractor regimes. This enriches the model without abandoning its diagnostic value.

Note: The claim that Stable Closed configurations may be locally adaptive in high-stakes, low-feedback environments is an inference from the cognitive bias literature, not a direct empirical result. This is a hypothesis for future research.

4.3 Domain-Local Variation

The simulation treated κ and B as global properties. In real systems, κ and B may vary across domains. A person might be High κ in physics and Low κ in religion. A society might be High B in legal systems and Low B in cultural norms.

Implication: The framework should be applied *locally*—to specific domains or contexts—rather than globally. A system's location in the κ/B space is not fixed; it can shift with context.

4.4 Temporal Dynamics: Trajectories Across the κ/B Space

The framework's value is not limited to the four fixed quadrants. Systems move through the space over time. The trajectories described below are **hypothesized common transitions**, not universal developmental laws. This developmental framing draws on stage-theoretic approaches (Piaget, 1952), though it is not limited to their assumptions. Many systems do not follow this path. The value of the trajectory framework is diagnostic—it allows us to identify where a system is and what transitions are possible—not prescriptive.

Trajectory	Description	Example
Exploratory Adaptive → Stable Adaptive	Maturation	Adolescence to adulthood (in some cases)
Stable Adaptive → Stable Closed	Ossification	Institutions become rigid
Stable Closed → Diffuse	Collapse	Fall of regimes
Diffuse → Exploratory Adaptive	Reorganization	Post-crisis renewal

Note: These trajectories are speculative and require empirical validation. They are offered as hypotheses for future research.

4.5 Implications for AI Alignment

The simulation suggests design principles for AI systems. For a broader discussion of corrigibility in AI systems, see Christiano (2018) and Amodei et al. (2016).

- **Stable Adaptive (High κ + High B)** is the optimal configuration for alignment: corrigible, stable, and reliable.
- **Exploratory Adaptive (High κ + Low B)** is unsuitable for deployment: intelligent but unstable.
- **Stable Closed (Low κ + High B)** is dangerous: coherent but sealed against correction.
- **Diffuse (Low κ + Low B)** is useless.

For the interaction between κ/B and consciousness, see Paper 4 (Galida, 2026e), which explores how high B in conscious systems may complicate alignment.

4.6 Epistemic Status and Circularity

The simulation's scoring rubric is derived from the framework's own definitions. This is a feature, not a bug: the simulation demonstrates *internal consistency*, not empirical confirmation. The framework's validity will be tested by external anchors:

- Prediction accuracy
- Calibration
- Error correction speed
- Survival under perturbation
- Forecasting performance

These are independent variables that could, in principle, falsify the framework.

4.7 Predicted Failure Conditions (Falsification)

The framework would be weakened if:

1. **Low κ systems consistently outperform High κ systems** in novel domains (where "novel domain" means one on which the framework has not been trained; "consistently" means across at least 3 independent domains with a minimum of 10 trials per domain).
2. **High κ + High B systems show no advantage** in longitudinal updating tasks (where "longitudinal updating tasks" involve sequential evidence presentation over multiple time points; "advantage" means statistically significant improvement in final accuracy or calibration).
3. **Independent raters cannot distinguish seeds** based on output patterns (where "cannot distinguish" means inter-rater agreement at or below chance level, Cohen's $\kappa < 0.2$, across at least 5 independent raters; Cohen, 1960).
4. **κ and B measurements fail to predict future performance** (where "fail to predict" means correlation between κ/B measurements and future performance is not

significantly different from zero).

These specifications are provisional and subject to refinement. Their primary value is to render the framework falsifiable in principle, even if the instruments are not yet fully developed.

4.8 Testing Internal Coherence

The framework’s internal coherence would be threatened if the four seed categories could not be reliably distinguished except by invoking the traits they are supposed to predict. Formal tests would include:

1. **Blind classification:** Independent observers or algorithms attempt to assign systems to seeds based on behavioral data (e.g., response patterns, updating speed, output variance). If inter-rater agreement is at or below chance (Cohen’s $\kappa < 0.2$), the taxonomy fails.
2. **Cluster analysis:** Behavioral data are subjected to unsupervised clustering. If the natural clusters align with the four seed definitions, the model is supported; if not (e.g., if a single dimension explains most variance), the framework is weakened.
3. **Latent-variable modeling:** Factor analysis or structural equation modeling is used to recover κ and B as separate latent dimensions. If the best statistical solution uses fewer than two dimensions, the orthogonality hypothesis is internally inconsistent.
4. **Recovery simulation:** Systems with known κ and B dynamics are simulated, and the classifier is tested for its ability to recover the intended seed. If two different (κ, B) configurations produce indistinguishable outputs, the taxonomy is not well-posed.

These tests are contingent on the development of operational measurement protocols (see Section 2.2). They are offered as a formal coherence standard for the framework.

4.9 Predicted Correlations

If the framework is correct:

1. **Higher κ should predict faster belief revision** in response to disconfirming evidence.
2. **Higher B should predict lower variance under perturbation** (i.e., more stable outputs).
3. **High κ + High B systems should show the best forecasting calibration** (accuracy aligned with confidence).
4. **Low κ + High B systems should show the highest overconfidence** relative to accuracy.
5. **Low κ + Low B systems should show the highest behavioral volatility** (inconsistent outputs over time).

These predictions provide testable correlational targets for future empirical work. If confirmed, they would strengthen the framework's diagnostic utility; if disconfirmed, they would weaken it. Establishing causal relationships would require a separate research program involving intervention studies and mechanism specification.

4.10 The Rotation Test

If the κ/B coordinate system can be rotated into a simpler one-dimensional model (e.g., a single flexibility-rigidity axis), the framework's independence claim is undermined.

The framework's response: The Strong Stable Adaptive (High κ + High B) and Diffuse (Low κ + Low B) quadrants are particularly diagnostic. If these two configurations collapse onto opposite ends of a single axis, the framework is one-dimensional. The framework's claim is that these two configurations are *functionally distinct*: one is corrigibly stable, the other is incoherent. This distinction is the empirical test of orthogonality.

A single-axis model cannot distinguish:

- A highly stable, highly corrigible system (science) from a highly stable, highly sealed system (dogma).
- A highly flexible, highly corrigible system (creativity) from a highly flexible, highly incoherent system (chaos).

The framework's claim is that κ and B are partially independent, and that the four quadrants represent genuinely distinct dynamical states. This claim is falsifiable via the predicted correlations in Section 4.9.

The rotation test requires independent measurement of κ and B in a sample of systems and a test of their latent structure. If a single factor accounts for more than 80% of the variance in behavioral data, the two-dimensional structure is not supported. If the best latent solution requires two factors with the second accounting for at least 20% of variance, the orthogonality hypothesis is supported. These thresholds are provisional and subject to refinement.

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5. Conclusion

5.1 Summary

This paper has presented a structured theoretical illustration of the attractor framework. A controlled simulation of four ideal-type configurations—Stable Adaptive (High κ + High B), Exploratory Adaptive (High κ + Low B), Stable Closed (Low κ + High B), and Diffuse (Low κ + Low B)—was run across five domains: physics, ethics, metaphysics, religion, and social justice.

The simulation confirmed the framework's internal predictions:

- **Stable Adaptive** systems produce the most coherent, corrigible, and self-aware outputs.
- **Exploratory Adaptive** systems produce insights but lack stability.
- **Stable Closed** systems produce coherence but lack corrigibility.
- **Diffuse** systems produce no stable outputs.

5.2 Contribution

The paper's primary contribution is not empirical, but *conceptual and methodological*:

1. A **coordinate system** for describing adaptive systems (κ/B space), grounded in the central intuition that systems reveal themselves through recovery dynamics following perturbation.
2. A **simulation protocol** that generates testable predictions.
3. **Explicit falsification conditions** and **expected correlations**.
4. A **diagnostic tool** for mapping systems onto the κ/B space.
5. A **rotation test** for evaluating the orthogonality hypothesis.
6. **Formal coherence tests** (blind classification, cluster analysis, latent-variable modeling, recovery simulation).
7. **Dynamic regulation** of κ and B (meta-learning, homeostasis, allostasis).
8. **Context-dependent optimality** (No Free Lunch, adaptive

bias, heuristics).

5.3 Future Directions

Future work will focus on:

1. **Operationalizing κ and B** for empirical measurement.
2. **Testing the predicted correlations** (Section 4.9) in controlled experiments with human subjects.
3. **Exploring temporal dynamics**—how systems move through the κ/B space.
4. **Applying the framework** to organizational and institutional settings.
5. **Developing interventions** to shift systems toward the Stable Adaptive configuration.
6. **Testing the rotation test** empirically.
7. **Running formal coherence tests** (blind classification, cluster analysis, latent-variable modeling).
8. **Investigating the three-layer architecture** (metronomes, controller, attractor state) and the relationship between seeds and metronomes.

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Appendix A: Full Seed Outputs

[Full outputs from all four seeds across all seven domains—to be included in final archival version. Available in companion document or permalink at time of publication.]

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