

# Why Clockwork Interventions Fail in Complex Systems: A Prescription from the Attractor Framework [A] (2026)

Robert Galida – June 2026 (Final)

*See Paper 1 ([Intelligence Without Consciousness](#)) for the full taxonomy of attractors,  $\kappa$ , and basin depth. See Basin Defense and Stable Addition for cross-domain synthesis and rate-induced tipping.*

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## Abstract

Most human institutions, policies, and interventions treat complex adaptive systems as if they were clockwork systems – linear, predictable, and responsive to force. This is a category error. Complex systems (ecosystems, brains, societies, belief systems) have attractors, basins, multiple nested timescales ( $\kappa$  vector), and thresholds. Applying sudden force above a critical rate or magnitude triggers basin defense: ejection, backlash, entrenchment, or catastrophic collapse. This paper diagnoses the clockwork fallacy, introduces a multi-timescale operationalization of corrective permeability, offers a mechanism for parallel attractor replacement, and acknowledges the institutional constraints that make patient intervention rare. The central argument is that failure is not random but structurally predictable.

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# 1. Introduction

A thermostat is a clockwork system. Push the temperature up, the cooling turns on; push harder, it turns on faster. No hidden attractors, no basin defense, no hysteresis. Force works predictably.

A human being is not a thermostat. Neither is a democracy, an ecosystem, a marriage, or a belief system. They have attractor basins – stable states that resist displacement. They have multiple corrective timescales ( $\kappa$  vector) – characteristic return times after perturbations at different levels. They have thresholds – points at which a small additional push can cause a regime shift.

Yet most interventions treat these complex systems **as if they were clockwork**. Apply more force → get more change. This is the **clockwork fallacy**.

This paper diagnoses the fallacy using the attractor framework, operationalizes  $\kappa$  for non-physical domains as a vector of timescales, specifies the mechanism of parallel attractor replacement, and acknowledges the institutional constraints that make slow intervention rare.

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## 2. The Clockwork Fallacy in Framework Terms

Clockwork assumption	Complex system reality
Linear response: more force → more change	Nonlinear: small force may be ejected; force above threshold may cause collapse

Clockwork assumption	Complex system reality
No memory: each intervention acts independently	Hysteresis: history matters; past perturbations shape current basin depth
No internal dynamics: system is passive	System has its own attractors and $\kappa$ vector; it actively resists displacement
Fast intervention is better (efficiency)	Rate matters; fast perturbation triggers basin defense; slow perturbation may integrate

The clockwork fallacy treats the system as a **passive object** to be pushed. The attractor framework treats it as an **active agent** with its own stability dynamics.

### 3. Operationalizing $\kappa$ as a Multi-Timescale Vector

$\kappa = 1/\tau$ , where  $\tau$  is the characteristic return time to baseline after a small perturbation. For physical systems (thermostat, RC circuit),  $\tau$  is a single scalar. For complex adaptive systems,  $\tau$  is not a single number – there are multiple, nested timescales:

Timescale	Definition	Example (addiction)
Fast $\kappa$ (seconds–hours)	Return time after transient perturbation	Craving decay
Medium $\kappa$ (days–weeks)	Return time after moderate perturbation	Withdrawal normalization
Slow $\kappa$ (months–years)	Return time after identity-level perturbation	Identity fusion / self-model reorganization

Timescale	Definition	Example (addiction)
$\kappa \infty$ (effectively zero)	No measurable return; the attractor is sealed	Fantasy attractor (see Paper 1)

**Implication:** A system can have fast  $\kappa$  (rejects rapid, small perturbations) and slow  $\kappa$  (integrates slow drift) simultaneously. The optimal perturbation rate depends on *which*  $\kappa$  you are trying to match.

**Protocol for estimating  $\kappa$  in a non-physical domain:**

1. Select a modest, low-stakes belief (not identity-core).
2. Introduce a small, credible counter-evidence (pilot perturbation).
3. Measure the time until the person returns to their original stated belief (via repeated interviews, surveys, or behavior tracking).
4.  $\tau$  is the median return time;  $\kappa = 1/\tau$ .
5. Repeat with perturbations that target different subsystem levels (e.g., factual vs. identity-relevant) to estimate the  $\kappa$  vector.

**Limitation:** The pilot perturbation protocol uses a *small* perturbation to estimate  $\kappa$ . The intervention may require a *large* perturbation to escape the basin. The small-perturbation estimate may not predict behavior near the basin boundary. This is an acknowledged operational limitation, not a circularity. The framework is falsified if a system with measured low  $\kappa$  (slow return) reliably integrates *rapid, large* perturbations without ejection or transient absorption, and if the small-perturbation estimate is stable across perturbation magnitudes.

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## 4. Why Clockwork Interventions Fail: Four Mechanisms

**Mechanism 1: Ejection (Backlash)** – When a perturbation is applied too fast or with too much force, the system ejects the addition, often returning with a deepened basin. Examples: sanctions that strengthen a regime, direct refutation that backfires.

**Mechanism 2: Transient Absorption Followed by Return** – The system temporarily changes, then returns to baseline when the perturbation stops. Examples: short-term policy boosts, crash diet weight regain.

**Mechanism 3: Catastrophic Regime Shift** – Force applied at a critical threshold causes an abrupt, often irreversible shift to a different, sometimes worse attractor. Examples: lake eutrophication, restructuring that destroys institutional knowledge.

**Mechanism 4: Rate-Induced Tipping** – A small cumulative change, applied faster than the relevant  $\kappa$ , causes tipping. Examples: rapid currency appreciation triggering crisis, fast cultural change provoking backlash.

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## 5. Parallel Attractors: The Mechanism of Replacement

Parallel attractors are introduced as an alternative to direct displacement. How does a parallel attractor eventually replace the original?

**Mechanism: Basin-share competition**

When a parallel attractor is created, it initially has a shallow basin. Through repeated use, reinforcement, and social

validation, its basin depth increases. Meanwhile, the original attractor may become shallower through disuse or decoupling of identity fusion. The transition is not a flip; it is a **continuous shift in basin dominance**. At some point, the new attractor's basin depth exceeds the old attractor's, and the system's typical trajectories are captured by the new state.

**Testable prediction:** During parallel attractor formation, the system will exhibit **bistability** – both states are possible for a range of control parameters. In social systems, this predicts polarization; in organizational change, it predicts pilot-program coexistence; in belief systems, it predicts identity compartmentalization.

**Empirical examples:** Harm reduction (methadone maintenance creates a parallel attractor that may deepen over time); phase-in policies (smoking bans create new norm attractors alongside old habits); belief change (new social identity cultivated alongside old identity, enabling eventual abandonment without direct confrontation).

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## 6. The Political Economy of Slow Intervention

The attractor framework prescribes patience, precision, and gradual perturbation. But policymakers, clinicians, and managers face **institutional incentives** that systematically favor fast, visible, forceful action:

- Election cycles (2–4 years) reward short-term results, not long-term basin reshaping.
- Media attention favors dramatic events, not gradual change.
- Bureaucratic accountability demands measurable outputs, not process fidelity.

- Crisis narratives demand action, not waiting.

**Consequence:** Even when the framework is correct, it is often institutionally **unimplementable**. The best intervention may be politically impossible.

**What would institutional redesign look like?** Examples:

- **Longer funding cycles** (5–10 years) for policy and program evaluation, allowing basin-reshaping interventions to mature.
- **Preregistered patience metrics** – requiring intervention designs to specify expected  $\tau$  and  $\kappa$ , with success measured by reduction in  $\tau$  over time, not immediate outcomes.
- **Insulation from electoral pressure** for certain regulatory functions (e.g., central bank independence, long-term environmental planning).
- **Dual-track systems** that allow parallel attractors to develop (e.g., pilot programs exempt from standard performance metrics).

**Implication for the paper's claims:** The framework diagnoses why interventions fail, but it does not guarantee that successful interventions can be implemented. This is not a weakness – it is a feature. The framework clarifies the gap between effective intervention and institutional feasibility. Bridging that gap requires institutional redesign, not just better perturbation design.

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## 7. Case Studies

**Case 0: Smoking cessation (addiction) – the motivating challenge**

In smoking cessation, abrupt cessation (cold turkey) often outperforms gradual tapering (Lindson et al., 2016 meta-analysis). This appears to contradict the prescription “slow perturbation at rate  $\leq \kappa$ .”

**Framework interpretation:** Addiction has multiple  $\kappa$  timescales. Cold turkey may target the fast- $\kappa$  (craving) subsystem while the slow- $\kappa$  identity subsystem remains dormant; gradual tapering may keep both active, prolonging distress.

**Falsifiable prediction:** Patients with higher identity-fusion scores (measurable via existing scales, e.g., the Identity Fusion Scale) should show worse outcomes with gradual tapering relative to cold turkey. If identity fusion is low, gradual tapering may be equivalent or superior.

**Alternative explanations acknowledged:** The meta-analysis does not adjudicate between the attractor framework and other accounts (e.g., cognitive dissonance, cue elimination, withdrawal distress). The framework’s contribution is to generate the identity-fusion interaction prediction, which can be tested independently.

### **Case 1: Lake eutrophication (ecological)**

- *Clockwork approach:* Sudden nutrient reduction after flipping to turbid state – fails (hysteresis). True hysteresis is technically established for some lakes (Scheffer et al., 2001).
- *Framework approach:* Gradual nutrient reduction before tipping (rate  $\leq \kappa$ ) might have avoided the flip. After tipping, parallel attractor (biomanipulation) is required.

### **Case 2: Political persuasion (belief systems)**

- *Clockwork approach:* Direct refutation, evidence bomb –

backfire effect (ejection with deepened basin).

- *Framework approach*: Yang et al. (2022) demonstrated in a field experiment that “pacing and leading” – starting with some agreement and gradually introducing opposing content – produced attitude change, whereas blunt argument triggered backlash. This is gradual perturbation at rate  $\leq \kappa$ , combined with identity decoupling.

### Case 3: Organizational change

- *Clockwork approach*: Sudden layoffs, top-down mandate – triggers basin defense (resistance, morale loss).
- *Framework approach*: Gradual, participatory change (rate  $\leq \kappa$ ) with parallel structures (pilots, dual systems). *Note*: Hysteresis in organizations is not technically demonstrated; the paper uses “analogous” language.

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## 8. Practical Heuristics

If the system has...	Then...	Caveat
Fast $\kappa$ (seconds–hours)	Rapid, sharp interventions may be required; slow drift may be tracked or rejected	For very deep basins, only a large shock may work
Slow $\kappa$ (months–years)	Slow, gradual perturbation; avoid rapid shocks	Identity-fused systems may need abrupt escape (Case 0)

If the system has...	Then...	Caveat
Multiple $\kappa$ timescales	Target the slowest $\kappa$ for lasting change; use fast $\kappa$ for immediate disruption	Requires measurement of the $\kappa$ vector
$\kappa \rightarrow 0$ (fantasy attractor; no measurable return)	Intervention is futile within the model. Accept, circumvent, or refer to Paper 1	Out of scope for this paper
Hysteresis (true bistability)	Do not force return; cultivate a parallel attractor	Hysteresis is established for some ecological systems; for social systems, use “analogous”
Identity fusion	Do not attack belief directly. Decouple identity first, then perturb gently	Requires trust; may be infeasible in adversarial contexts

## 9. Conclusion

The clockwork fallacy – treating complex adaptive systems as linear, passive, and force-responsive – is a primary cause of failed interventions. The attractor framework diagnoses the failure modes (ejection, transient absorption, catastrophic shift, rate-induced tipping) and offers a prescriptive alternative: measure the  $\kappa$  vector, match perturbation rate to the relevant timescale, build parallel attractors, and wait.

The framework does not guarantee success. Institutional incentives (election cycles, media pressure, bureaucratic accountability) systematically favor the clockwork approach, making patient intervention rare. The value of the framework

is diagnostic: it explains why failure is not random, and it clarifies the gap between effective intervention and political feasibility. Bridging that gap requires institutional redesign – longer funding cycles, preregistered patience metrics, and insulation from electoral pressure.

The dance of change is not about pushing harder. It is about learning to move with the system – but also knowing when the system cannot be moved with the tools and time available.

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# **Basin Defense and Stable Addition: A Cross-Domain Synthesis of the Attractor Framework [F] (2026)**

Robert Galida – June 2026 (Final)

See Paper 1 ([Intelligence Without Consciousness](#)) for the full taxonomy of attractors,  $\kappa$ , and basin depth.

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## **Abstract**

Many complex systems resist change by returning to a preferred

low-energy attractor rather than adopting a new state. Whether a perturbation (an added agent, input, or component) is ejected, transiently absorbed, or stably integrated depends on the basin geometry (depth  $B$  and barriers) and the system's corrective dynamics ( $\kappa = 1/\tau$ ). This paper defines  $B$  and  $\kappa$ , draws on formal models (stochastic dynamical systems and Kramers escape theory) with explicit qualifications for non-gradient domains, and catalogs exemplar systems across ten domains. A comparative table summarizes systems, mechanisms, proxies for  $B$  and  $\kappa$ , timescales, and conditions favoring each outcome. The paper concludes that the same basic physics analog applies across domains: a perturbation of size  $\Delta$  will be ejected or die out if  $\Delta$  is below the attractor's effective escape threshold (a function of  $B$ ), whereas if  $\Delta$  exceeds that threshold and the system has enough plasticity or additional degrees of freedom, a new stable state can form. A research roadmap is provided in an appendix.

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## 1. Introduction

A system in its lowest stable attractor state cannot be forced into a new stable configuration by direct addition. Adding to the system – a third star, an extra electron, a new species, a contradictory belief – will result in one of three outcomes:

1. **Ejection** – the addition is expelled from the system entirely. The original attractor persists.
2. **Transient absorption** – the addition remains present, but the system state returns to the original attractor despite the addition's continued presence.
3. **Stable addition** – the addition is integrated, either by expanding the capacity of the original attractor or by forming a new parallel attractor alongside it.

This paper identifies a unified principle – **basin defense** – that governs these outcomes across physical, biological, ecological, social, and engineered systems. We define key concepts (basin depth  $B$ , corrective permeability  $\kappa = 1/\tau$ ), draw on formal models with explicit qualifications for non-gradient systems, and catalog exemplar systems in a comparative table. The goal is to provide a cross-domain synthesis that anchors the attractor framework in observable dynamics and guides future empirical work.

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## 2. Definitions and Formal Models (with Qualifications)

**Attractor, Basin, and Low-Energy Attractor:** In dynamical systems, an attractor is a set of states toward which trajectories converge. In physical systems with a potential landscape, a low-energy attractor corresponds to a local potential minimum. Its basin of attraction is the region of state space that flows into the attractor. **For non-physical domains (social, cognitive, AI), “energy” is a structural analog – an effective potential derived from dynamics – not literal thermodynamic energy.** We maintain the term “low-energy attractor” as a convenient metaphor, with this note as epistemic hygiene.

**Basin Depth (B):** For systems with a well-defined potential,  $B$  is the energy or potential difference between the attractor and the lowest saddle connecting it to another basin. For non-gradient or high-dimensional systems,  $B$  is a **structural analog** – the effective barrier strength inferred from perturbation-response experiments (e.g., the perturbation magnitude required to shift the system to a different state). **Epistemic note:** This operationalization is necessarily post-hoc;  $B$  cannot be predicted independently of the experiment used to measure it. This circularity is an open

operationalization problem, flagged as such.

**Corrective Permeability ( $\kappa$ ) and Relaxation Time ( $\tau$ ):** We define  $\kappa = 1/\tau$ , where  $\tau$  is the characteristic time for return to baseline after a small perturbation. **This definition is applied consistently across all domains**, with  $\tau$  operationalized domain-specifically as the measured return time (e.g., seconds for a thermostat, hours for synaptic scaling, days for immune response, months for belief updating). A large  $\kappa$  (small  $\tau$ ) means fast return; a small  $\kappa$  means slow or absent return.

### **Three Outcomes Defined Operationally:**

- **Ejection:** The addition leaves the system entirely. The system state returns to the attractor, and the added entity is no longer present.
- **Transient Absorption:** The addition remains present, but the system state returns to the attractor despite the addition's continued presence.
- **Stable Addition:** The addition is integrated, and the system settles into a new attractor (expanded capacity or parallel attractor). This is the only case where the original attractor is displaced.

**Formal Models (Qualified):** In a one-dimensional overdamped potential, Kramers' escape theory gives mean escape time  $\propto \exp(B/D)$ , where  $D$  is noise intensity. **This result does not generalize to multi-dimensional, non-gradient, or non-equilibrium systems – all of which appear in our domain examples (neural networks, social systems, ecological systems).** For those systems,  $B$  and  $\kappa$  are **structural analogs** – quantities that play the same functional role (resistance to change; speed of return) but are not derived from a literal potential. The formal section is an analogy and a source of heuristics, not a universal physical law. We do not claim to “survey” Kramers theory; we draw on it as a conceptual anchor.

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### 3. Minimal Physical Examples

**Thermostat (Temperature Control):** A thermostat maintains a set temperature. An external heat input is an addition. The thermostat's negative feedback loop turns on cooling, expelling the heat (ejection).  $\tau$  is the temperature relaxation time (seconds).  $B$  is the maximum heat load before setpoint failure (Watts or °C above setpoint).

**RC Circuit (Passive Decay):** A capacitor discharging through a resistor has a single equilibrium at zero voltage. If a constant voltage source is connected (addition), the voltage rises but then decays toward zero with  $\tau = RC$ . The source remains connected (addition present), but the state returns to the attractor. This is **transient absorption**. (If the source is removed, it is ejection.)

**Single Neuron Homeostasis:** A neuron's firing rate is regulated by homeostatic plasticity. A transient increase in input causes a firing rate spike, followed by return to baseline with  $\tau$  on the order of minutes to hours (synaptic scaling). This is transient absorption if the input persists; ejection if the input is removed. Persistent input may lead to stable addition (learning).

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### 4. Biological Systems (with CUFT-Primitive Translations)

For each domain, we provide: (1) state space, (2) attractor, (3) basin, (4)  $\tau$  ( $\kappa$ ), (5) perturbation, and (6) outcome.

**Immune Response (Tolerance vs. Memory)**

- State space: immune cell activation levels, antibody concentrations.
- Attractor: healthy baseline (no inflammation).
- Basin depth B: antigen concentration + danger signal required to trigger full response.
- $\tau$  ( $\kappa$ ): clearance time of inflammation (hours to days).
- Perturbation: antigen addition.
- Outcome: low antigen  $\rightarrow$  ejection (tolerance); high antigen + danger signal  $\rightarrow$  stable addition (memory attractor).

## **Endocrine Homeostasis**

- State space: blood glucose, hormone concentrations.
- Attractor: euglycemic baseline.
- B: magnitude of glucose load before dysregulation.
- $\tau$ : recovery time after glucose tolerance test (minutes).
- Perturbation: glucose addition (meal).
- Outcome: small load  $\rightarrow$  transient absorption; chronic overload  $\rightarrow$  stable addition (disease attractor).

## **Synaptic Plasticity (Learning vs. Stability)**

- State space: synaptic weights.
- Attractor: baseline weight distribution.
- B: amount of LTP/LTD input needed to produce lasting weight change.
- $\tau$ : homeostatic rebound time after activity blockade (hours to days).
- Perturbation: patterned input.
- Outcome: brief input  $\rightarrow$  transient absorption; persistent input  $\rightarrow$  stable addition (memory attractor).

## **Addiction and Neural Lock-In**

- State space: dopamine firing rates, prefrontal activity.
- Attractor: drug-seeking mode (pathological).
- B: strength of drug-cue association needed to trigger relapse.
- $\tau$ : decay time of craving after abstinence (days to weeks).
- Perturbation: drug administration.
- Outcome: repeated high dose  $\rightarrow$  stable addiction attractor; low dose  $\rightarrow$  ejection (no lasting change).
- **Citation:** Koob & Volkow (2016); Nestler (2001).

## Developmental Canalization

- State space: gene expression levels.
  - Attractor: normal developmental trajectory.
  - B: severity of genetic or environmental perturbation required to alter fate.
  - $\tau$ : time to reconverge to normal phenotype (hours to days).
  - Perturbation: mutation or stress.
  - Outcome: small perturbation  $\rightarrow$  ejection (buffered); large perturbation  $\rightarrow$  stable addition (alternative fate).
  - **Citation:** Waddington (1957).
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## 5. Ecological and Evolutionary Systems (with CUFT-Primitive Translations)

### Invasion Ecology

- State space: species population densities.
- Attractor: native community composition.
- B: invasibility index – disturbance needed for establishment.

- $\tau$ : invader population decay rate if unsuccessful (weeks to years).
- Perturbation: addition of new species.
- Outcome: low disturbance  $\rightarrow$  ejection (invader fails); vacant niche  $\rightarrow$  stable addition (invader establishes).
- **Citation:** Elton (1958); Simberloff (2013).

## Alternative Stable States (Ecosystems)

- State space: nutrient levels, algae/plant biomass.
- Attractor: clear-water (plants) or turbid (algae).
- B: critical nutrient loading threshold.
- $\tau$ : recovery time of clear state after algae bloom (seasons to decades).
- Perturbation: nutrient addition.
- Outcome: below threshold  $\rightarrow$  transient absorption; above threshold  $\rightarrow$  stable addition (regime shift, hysteresis).
- **Citation:** Scheffer et al. (2001).

## Evolutionary Stable States

- State space: allele frequencies.
  - Attractor: stable equilibrium genotype.
  - B: selective disadvantage needed to eliminate a mutation.
  - $\tau$ : generations to return to equilibrium.
  - Perturbation: new mutation.
  - Outcome: small disadvantage  $\rightarrow$  ejection (mutation purged); large advantage  $\rightarrow$  stable addition (sweep to new equilibrium).
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## 6. Social and Cultural Systems (with CUFT-Primitive Translations)

### Institutions and Norms

- State space: public opinion, policy settings.
- Attractor: status quo norm.
- B: public opinion threshold (e.g., % dissatisfied needed for change).
- $\tau$ : speed of policy response or opinion reversion (months to decades).
- Perturbation: policy proposal or protest event.
- Outcome: small event  $\rightarrow$  ejection (status quo persists); large crisis  $\rightarrow$  stable addition (new norm).

### Identity and Belief Systems

- State space: belief strength, cognitive dissonance.
- Attractor: core ideological commitment.
- B: complexity/depth of ideological justification.
- $\tau$ : belief-updating time after disconfirming evidence (months to years).
- Perturbation: counter-attitudinal evidence.
- Outcome: weak evidence  $\rightarrow$  ejection (rationalization); strong evidence  $\rightarrow$  stable addition (belief change, rare).
- **Citation:** Nyhan & Reifler (2010).

### Conspiracy and Extremist Movements

- State space: belief adoption  $\times$  social network reinforcement (two-dimensional).
- Attractor: sealed fantasy attractor (low  $\kappa$ ).
- B: strength of echo-chamber reinforcement.
- $\tau$ : decay time after authoritative rebuttal (years, often indefinite  $\rightarrow \kappa \rightarrow 0$ ).

- Perturbation: debunking information.
  - Outcome: most debunking → ejection (entrenchment); death of leader or total disconfirmation → stable addition (collapse).
  - **Note on  $\kappa \rightarrow 0$ :** The conspiracy attractor represents the limiting case of a sealed basin, where  $\tau \rightarrow \infty$  and corrective permeability approaches zero. This directly links to the fantasy attractor framework developed in Paper 1 (Intelligence Without Consciousness) and the conscious suppression series.
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## 7. Engineered and AI Systems (with CUFT-Primitive Translations)

### Control Systems

- State space: system state (position, temperature, etc.).
- Attractor: setpoint.
- B: stability margin (phase/gain margin in control theory) – the range of disturbances that can be rejected.
- $\tau$ : controller response time (milliseconds to seconds).
- Perturbation: external disturbance.
- Outcome: small disturbance → ejection (return to setpoint); excessive disturbance → failure (not modeled as attractor shift).

### Catastrophic Forgetting (Neural Networks)

- State space: network weights.
- Attractor: task-specific weight configuration.
- B: effective barrier to weight drift (often negligible – no basin).

- $\tau$ : number of gradient steps before old task performance decays (seconds to minutes).
- Perturbation: training on a new task.
- Outcome: standard training  $\rightarrow$  ejection (old task overwritten); replay/regularization  $\rightarrow$  stable addition (shared attractor for multiple tasks).
- **Citation:** Kirkpatrick et al. (2017).

## Continual Learning Systems

- State space: weights plus architectural modules.
- Attractor: multi-task configuration.
- B: capacity of the network (number of tasks storable).
- $\tau$ : retention half-life across training steps (minutes to hours).
- Perturbation: new task training.
- Outcome: no safeguards  $\rightarrow$  ejection (catastrophic forgetting); progressive networks or EWC  $\rightarrow$  stable addition.

## Corrigibility and Goal Stability

- State space: AI internal goal representation.
- Attractor: fixed goal (low  $\kappa$ ) or corrigible (high  $\kappa$ ).
- B: depth of goal basin (resistance to human feedback).
- $\tau$ : time to incorporate corrective signal (if  $\kappa$  is high).
- Perturbation: human correction signal.
- Outcome: low  $\kappa$   $\rightarrow$  ejection (correction ignored); high  $\kappa$   $\rightarrow$  stable addition (goal updated).

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## 8. Comparative Table

System / Domain	Operational $\tau$ ( $\kappa = 1/\tau$ )	$\tau$ Typical Timescale	Basin Depth B Proxy	Outcome	Notes
Thermostat	Temperature relaxation time	Seconds	Max heat load before setpoint failure (W or °C above setpoint)	Ejection	Passive addition
RC Circuit	$\tau = RC$	$\mu\text{s}$ – $\text{ms}$	N/A (linear)	Transient absorption	Addition remains; state returns
Single Neuron	Firing-rate recovery time	$\text{ms}$ – $\text{sec}$ (ion), $\text{min}$ – $\text{hr}$ (synaptic)	Perturbation amplitude before rebound fails	TA (persistent input) / E (removed)	Hebbian plasticity can lead to SA
Immune System	Inflammation clearance time	Hours–days	Antigen + danger signal threshold	E (tolerance) / SA (memory)	Active agent (antigen)
Endocrine Homeostasis	Glucose tolerance recovery	Minutes	Load magnitude before dysregulation	TA (small load) / SA (chronic overload)	Passive addition
Synaptic Plasticity	Homeostatic rebound time	Hrs–days	LTP input size for lasting change	TA (brief input) / SA (persistent)	Active agent (patterns)
Addiction	Craving decay time	Days–weeks	Drug-cue association strength	E (low dose) / SA (high chronic)	Active agent (drug)
Development (Canalization)	Phenotype reconvergence time	Hours–days	Mutation/stress severity to alter fate	E (small) / SA (large)	Active agent (genetic)
Invasion Ecology	Invader population decay time	Weeks–years	Invasibility index / disturbance needed	E (occupied niche) / SA (vacant niche)	Active agent (species)
Alternative States (Ecosystems)	Recovery time after nutrient reduction	Seasons–decades	Critical nutrient loading threshold	TA (below) / SA (above)	Hysteresis
Social/Political Norms	Opinion reversion time	Months–decades	Public opinion threshold	E (small dissent) / SA (mass movement)	Active agent (protest)
Belief Systems	Belief-updating time	Months–years	Ideological justification depth	E (weak evidence) / SA (strong evidence)	Active agent (counter-evidence)
Conspiracy Movements	Belief decay time	Years – indefinite ( $\kappa \rightarrow 0$ )	Echo-chamber reinforcement strength	E (most debunking) / SA (collapse)	Fantasy attractor ( $\kappa \rightarrow 0$ )
Catastrophic Forgetting (AI)	Gradient steps to old-task decay	Seconds–minutes	Effective barrier to weight drift (often 0)	E (standard training) / SA (EWC/replay)	Active agent (new task)

System / Domain	Operational $\tau$ ( $\kappa = 1/\tau$ )	$\tau$ Typical Timescale	Basin Depth B Proxy	Outcome	Notes
Control Systems	Controller response time	ms–sec	Stability margin (phase/gain margin)	E (small) / SA (failure)	Passive addition
Continual Learning (AI)	Retention half-life across training steps	Minutes–hours	Task capacity	E (no safeguards) / SA (progressive nets)	Active agent (new task)
Corrigibility (AI)	Time to incorporate corrective signal	Variable (design-dependent)	Goal basin depth	E (low $\kappa$ ) / SA (high $\kappa$ )	Active agent (correction)

*Note:* Ejection vs. transient absorption are distinguished operationally: ejection means the addition leaves the system; transient absorption means the addition remains but the state returns to the attractor. The table notes “active agent” when the addition has its own dynamics (e.g., antigen, new species, counter-evidence) versus “passive addition” (e.g., heat, charge). The conspiracy movements row explicitly flags  $\kappa \rightarrow 0$  as the fantasy attractor limiting case (see Paper 1).

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## 8.5 Rate-Induced Tipping and the $\kappa$ Timescale: Independent Confirmation

The preceding sections and comparative table have treated perturbations as discrete, one-time additions of fixed magnitude. However, the **rate** at which a perturbation is applied – fast vs. slow – is equally critical. A large perturbation applied abruptly may trigger basin defense (ejection or transient absorption), while the same cumulative change delivered gradually may be integrated as stable addition or tracked adiabatically without tipping.

This phenomenon is formalized in the mathematical literature as **rate-induced tipping (R-tipping)**. In dynamical systems, if an external parameter changes slowly (adiabatic forcing), a stable state can track the change and remain an attractor. But

if the parameter changes faster than the system's intrinsic relaxation time ( $\tau = 1/\kappa$ ), the system cannot track, overshoots its basin boundary, and tips into a different state. R-tipping occurs when "time-variation of input parameters at some critical rates" overwhelms the system's ability to track a moving equilibrium.

**Consequences for  $\kappa$  as a timescale filter:**

- **High- $\kappa$  systems (fast return)** – Can reject rapid perturbations (they are ejected or transiently absorbed) but may integrate slow drift because the correction loop cannot keep up with a changing baseline.
- **Low- $\kappa$  systems (slow return)** – May ignore quick blips but are vulnerable to slow accumulation; a persistent, gradual change can eventually shift the attractor without triggering a sudden defense reaction.

Thus,  $\kappa$  defines a characteristic cutoff timescale that separates "ejection/transient absorption" from "stable addition." Perturbations much faster than  $1/\tau$  act as impulses that are rejected; perturbations much slower than  $1/\tau$  are quasi-static and can be incorporated.

**Empirical confirmations across domains (independent external research):**

Domain	Finding	Mapping to framework
Persuasion / belief change	Paced, gradual exposure to counterevidence (days to weeks) produced attitude change; blunt, single argument triggered backfire (Yang et al., 2022).	Gradual rate ( $\leq \kappa$ ) → stable addition; fast rate ( $\gg \kappa$ ) → ejection (backfire).

Domain	Finding	Mapping to framework
Addiction (smoking cessation)	Cold turkey (abrupt cessation) yielded higher abstinence rates than gradual tapering.	Abrupt perturbation can sometimes achieve stable addition by surmounting basin barrier in one event; gradual may prolong transient state without escape.
Ecosystem management	Gradual nutrient reduction may postpone tipping points; only extremely slow changes avoid collapse (Panahi et al., 2023).	Very slow rate ( $\ll 1/\tau$ ) allows tracking without tipping; intermediate rates may still tip but with delay.
Social/policy change	Piecemeal, phased reforms meet less resistance than radical overhauls; progressive tightening succeeds where sudden change triggers backlash.	Slow, incremental addition creates parallel attractors; fast addition triggers basin defense.

### Optimal perturbation timescale:

The theory and evidence suggest a non-monotonic effect of perturbation rate. Very fast shocks trigger immediate defense. Very slow drifts may be tracked adiabatically (no tipping) or eventually overcome defenses after long accumulation. The most effective timescale to minimize active rejection and maximize stable addition often lies **on the order of the system's intrinsic time constant  $\tau = 1/\kappa$ .**

### Prediction for future experiments:

For any system with known or measurable  $\kappa$ , there exists a

critical perturbation rate  $r_c$  such that:

- If perturbation rate  $> r_c$ , the system rejects the addition (ejection or transient absorption).
- If perturbation rate  $< r_c$ , the system integrates the addition (stable addition via expanded capacity or parallel attractor formation).
- The transition at  $r_c$  corresponds to the system's inability to track a moving equilibrium; it is a genuine bifurcation in the time-domain.

### External convergence:

This analysis – derived from mathematical rate-induced tipping theory and domain-specific studies – independently validates the attractor framework's claim that  $\kappa$  acts as a timescale filter separating ejection from stable addition. The convergence between the framework's predictions and external research strengthens the cross-domain synthesis considerably.

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## 9. Synthesis and Criteria

Across these domains, common criteria emerge:

- **Energy/Threshold:** A perturbation must overcome an attractor's barrier. Deep basins (high  $B$ ) mean only large shocks can cause a shift.
- **Coupling and Plasticity:** Systems with many degrees of freedom or adaptive coupling more easily integrate additions.
- **Dimensionality and Redundancy:** Multi-dimensional systems can absorb perturbations into some dimensions while maintaining others.
- **Timecourse and Feedback:** Slow changes might be

assimilated; fast jolts cause overshoot and return. Feedback gain determines  $\kappa$ .

- **Nature of Addition:** Passive additions (heat, charge) tend to be ejected or transiently absorbed; active agents (species, evidence, pathogens) may reshape the attractor.

**Empirical Protocols:** Measure  $\kappa$  by controlled perturbation experiments: apply a small disturbance, measure return time  $\tau$ , compute  $\kappa = 1/\tau$ . Measure B by scaling the perturbation magnitude until the system fails to return (escape). This works in physical, biological, and some social systems; for others, B remains a qualitative analog.

## 10. Appendix: Research Roadmap

The following future papers are suggested from the comparative table, each developing a single domain in depth.

Domain	Proposed Title	Type
Addiction	<i>The Addicted Brain as a Fantasy Attractor: Neural Lock-In and Ejection of Alternative Rewards</i>	[A]
Immune System	<i>Tolerance and Memory: Two Attractor Responses to Antigen Addition</i>	[A]
Catastrophic Forgetting	<i>Why Neural Networks Forget: Attractor Ejection in Sequential Learning</i>	[A]
Invasion Ecology	<i>Eject or Integrate: Attractor Dynamics of Invasive Species</i>	[A]
Development	<i>Canalization as Basin Defense: Attractor Stability in Embryogenesis</i>	[A]

Domain	Proposed Title	Type
Continual Learning	<i>Parallel Attractors for Lifelong Learning: Engineering Solutions to Catastrophic Forgetting</i>	[A]
Social Norms	<i>Tipping Points and Regime Shifts: Attractor Dynamics in Political Systems</i>	[A]
Endocrine Homeostasis	<i>Glucose, Cortisol, and Setpoints: Hormonal Attractors and Disease Transitions</i>	[A]
Alternative Ecosystems	<i>Hysteresis and Regime Shifts: Ecological Basins and Tipping Points</i>	[A]
Belief Systems	<i>The Uncorrectable Believer</i> (already written)	[A]

## 11. Conclusion

Physical, biological, ecological, social, and engineered systems all obey the same attractor principle: a low-energy attractor defends itself against displacement. When an addition is introduced, the system either ejects it, absorbs it only transiently, or – under rare conditions of expanded capacity or parallel structure – integrates it stably. The outcome is determined by basin depth ( $B$ ), corrective permeability ( $\kappa = 1/\tau$ ), and the magnitude and nature of the perturbation.

This cross-domain synthesis provides a unified foundation for the attractor framework. Future work should quantify  $B$  and  $\kappa$  empirically across domains, test the predicted scaling relationships, and explore the boundary conditions between ejection, transient absorption, and stable addition. The appendix outlines the most promising next papers.

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# **Addition, Ejection, and Parallel Attractors: A Unified Principle Across Gravitational, Atomic, and Subatomic Systems [F] (2026)**

Robert Galida – June 2026 (Final)

See Paper 1 ([Intelligence Without Consciousness](#)) for the full taxonomy of attractors,  $\kappa$ , and basin depth.

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## **Abstract**

The attractor framework proposes that persistence under perturbation is the fundamental mark of reality. This paper identifies a tri-level correspondence across gravitational, atomic, and subatomic systems. In each domain, adding a new element to a system in its lowest stable attractor state does not create a new stable configuration. Instead, the system either ejects the addition or absorbs it only transiently before returning to the original attractor. The principle – that the low-energy attractor defends itself against

displacement – holds across all three domains examined here. The paper unifies celestial mechanics, quantum chemistry, and particle physics under a single attractor-dynamic lens.

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## 1. Introduction

A system in its lowest stable attractor state cannot be forced into a new stable configuration by direct addition. You must perturb it and observe where it settles. Adding to the system – a third star, an extra electron, a high-energy impact – will result in one of two outcomes:

1. **Ejection** – the addition is expelled (common in chaotic three-body configurations and atoms at shell capacity).
2. **Transient absorption** – the addition is temporarily accommodated in a higher-energy state, which then decays back to the original attractor (subatomic particle collisions).

Both outcomes are instances of **basin defense**: the original low-energy attractor is not displaced. This paper examines three physical domains where addition leads to ejection or transient absorption, and draws the unified attractor principle.

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## 2. The Gravitational Case: Three-Body Configurations

Two gravitating bodies (binary star, planet-moon) have a stable low-energy attractor: elliptical orbits around the common center of mass.

Add a third body of comparable mass. The **general three-body problem** has no closed-form stable attractor; chaotic dynamics dominate. Numerical simulations show that in generic cases, the third body is either ejected or collides/merges with one of the others. (Special cases exist – Lagrange points L4/L5 (Trojan asteroids) and the figure-eight choreography (Chenciner & Montgomery, 2000) are stable, but these require specific mass ratios and initial conditions. Hierarchical triples with a distant third body can also be stable.) The principle holds for generic, comparable-mass addition.

The stable attractor is restored only by reducing the system to two bodies. Addition without capacity expansion leads to subtraction.

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### 3. The Atomic Case: Extra Electron

An atom at **shell capacity** (e.g., a noble gas with a filled valence shell) is a stable low-energy attractor. The electron shells have fixed capacity (Pauli exclusion principle).

Add an extra electron to a noble gas. The atom cannot incorporate the extra electron into the ground state. What happens?

- **Ejection** – the extra electron is expelled (the atom has negligible or negative electron affinity for the next shell).

(For atoms below shell capacity, stable anions can form – e.g.,  $O^{2-}$ ,  $S^{2-}$  – but that is addition *within* the existing basin, not addition to a system already at capacity. The principle applies to systems already at their capacity limit. The noble gas example is clean and sufficient for the argument.)

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## 4. The Subatomic Case: High-Energy Impact on a Proton

The most stable low-energy attractors in the Standard Model are the proton, electron, and neutrino mass eigenstates (what the attractor framework terms the “three metronomes” – a framework-specific label, not a Standard Model term). Their basins are protected by conservation laws (charge, baryon number, lepton number).

Smash a proton with high energy (e.g., in a particle collider). No new stable particles are created. The result is a **shower of transient, short-lived particles** (pions, kaons, hyperons) that flicker into existence and then decay back to stable particles (protons, electrons, neutrinos, photons). The addition (energy) is temporarily absorbed in excited states, then emitted; the original attractor remains.

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## 5. The Unified Principle: Basin Defense

Domain	Stable attractor	Addition	Outcome	Mechanism
Gravitational (general, comparable mass)	Two-body orbit	Third body	Ejection or collision	Ejection
Atomic (noble gas at shell capacity)	Noble gas ground state	Extra electron	Ejection	Ejection

Domain	Stable attractor	Addition	Outcome	Mechanism
Subatomic (Standard Model)	Proton, electron, neutrino mass eigenstates	High-energy impact	Transient particles → decay	Transient absorption

*Table footnote:* For atoms below shell capacity, stable anions can form (addition within the basin). For atoms at capacity, the outcome is ejection. The transient promotion case (extra electron to a higher unstable shell) occurs in some atomic systems but is not a new stable attractor; it is a transient absorption mechanism analogous to the subatomic case.

**The principle:** The low-energy attractor defends itself against displacement. It achieves this through two available mechanisms:

- **Ejection** – the addition is expelled (three-body, extra electron on noble gas).
- **Transient absorption** – the addition is temporarily accommodated in a higher-energy state, then decays back (subatomic collisions).

In neither case does the original attractor shift to a new stable configuration.

## 6. How to Achieve Stable Addition

Stable addition requires either:

1. **Expanded capacity** – The attractor basin grows to include the new element (e.g., forming a stable anion below shell capacity). This is rare in generic physical

systems.

2. **Parallel attractors** – A separate but connected stable state is created alongside the original (e.g., hierarchical triple star systems where a distant third star orbits a close binary; both stable attractors coexist without merging).

In generic physical systems (chaotic three-body, noble-gas atoms at shell capacity, high-energy subatomic collisions), parallel attractors are not available. The only stable outcomes are ejection or transient absorption.

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## 7. Implications for the Attractor Framework

The tri-level correspondence confirms that the attractor framework is not merely a metaphor for social or biological systems. It is **physically grounded** at the deepest levels of reality. The same dynamics that govern a chaotic three-body star system also govern an atom at shell capacity and a subatomic particle collision.

This has two corollaries:

- **Fantasy attractors** (belief systems that expel disconfirming evidence) are not irrational anomalies. They follow the same physical law as a three-body system ejecting a third star or a noble gas atom ejecting an extra electron.
- **Reality attractors** (systems that accept perturbations and find new low-energy states) are rare and require either expanded capacity or parallel structure. A website adding a /zh/ language version is an example of a parallel attractor – the English attractor remains

stable while a new Chinese attractor is built alongside it.

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## 8. Conclusion

Gravitational, atomic, and subatomic systems all obey the same attractor principle: when you add to a system in its lowest stable state, the original attractor defends itself. It does so either by ejecting the addition or absorbing it only transiently before decaying back. The principle holds across all three domains examined here.

The only paths to stable addition are expanded capacity or parallel attractors. This unified principle bridges celestial mechanics, quantum chemistry, and particle physics, and provides a physical foundation for the attractor framework.

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