

White Paper: Coherence as a Research Program

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Abstract

We propose coherence as a measurable systems parameter, denoted $\kappa = S/V$.

- S = stabilized signal, the fraction of output that holds under recursive stress.
- V = latent potential, the total available capacity of the system.

We hypothesize that κ behaves as a **dimensionless ratio** across domains, analogous to the Reynolds number in fluid dynamics: not an absolute constant like c , but a structural invariant that predicts stability, fragility, or collapse under pressure.

This paper outlines:

- Conceptual definition.
- Domain-specific operationalizations.
- Candidate algorithm for measurement.
- Null hypothesis and falsifiability criteria.
- Path to empirical validation.

1. Definition

- **Law:** $\kappa = S/V$, where $0 \leq \kappa \leq 1$.
- **Interpretation:** κ is the fraction of potential converted into stable, distortion-resistant signal.
- **Properties:**
 - Dimensionless.
 - Cross-domain (text, biological, cultural, physical).
 - Sensitive to stress: incoherent systems collapse, coherent ones stabilize.

2. Operationalization by Domain

κ requires clear **system boundaries**. A sentence, a match, or a season may each be defined as “the system,” but κ will vary with scope. Establishing scaling rules across boundary definitions is part of this program.

We propose first-order proxies for V (latent potential) and S (stabilized signal):

- **Text**
 - V = entropy of original sequence (bits).
 - Distortion: recursive paraphrase/noise injection.
 - S = mutual information preserved after stabilization.
 - **Football / Rugby**
 - V = total attacking possessions.
 - S = coherent outcomes (goals, tries).
 - κ = scoring efficiency reframed as coherence index.
 - **Neuroscience**
 - V = baseline neural firing capacity.
 - Task: rhythmic chanting or synchronized task.
 - S = synchronized activity fraction (EEG/MEG coherence).
 - **Therapy / Dialogue**
 - V = total dialogue duration.
 - S = stabilized recognition events (proxies: recurrence of agreed-upon terms, reduction in conversational entropy, or synchrony in speech/physiology).
 - Note: this is the hardest domain to quantify; developing rigorous proxies is a research frontier.
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3. Algorithmic Approach

Clarus operationalizes κ via **recursive distortion testing**:

1. **Input**: system output (text, signal, model, dataset).
2. **Apply distortion**: noise injection, phase jitter, substitution.
 - *Stress types are domain-specific*. Different distortions may reveal different aspects of coherence. Testing stress types is itself part of the program.
3. **Iterate recursively**: each cycle amplifies weak patterns.
4. **Stabilization criterion**:
 - Subset of output whose variance falls below a threshold after N cycles, or
 - Subset with mutual information above a set threshold relative to original.
5. **Ratio**: $\kappa = S/V$.

This process is transparent, repeatable, and content-agnostic.

4. Null Hypothesis and Falsifiability

- **Null hypothesis**: κ values are random and show no attractor behavior under stress.
- **Predicted observation**: κ converges within bounded ranges across diverse domains when tested under recursive stress.
- **Alternative outcomes**:
 - Different classes of systems may stabilize at characteristic bands (e.g., engineered systems $\kappa \sim 0.9$, adaptive social systems $\kappa \sim 0.7$).
 - If so, κ may serve as a biomarker for system type and fragility.
- **Falsification**:
 - κ diverges unpredictably.
 - κ fails to stabilize under repeated stress.
 - No correlation between κ and observed robustness.

5. Candidate Experiments

- **Text domain:** apply recursive distortion to scientific abstracts; compute κ across iterations.
- **Neural synchrony:** measure κ during group chanting or tasks.
- **Sport:** analyze historical match data (possessions vs scoring outcomes).
- **Engineering:** stress-test CAD designs under perturbations; compute κ for features that stabilize.

Each experiment produces domain-specific κ values. Cross-domain comparison tests whether κ exhibits attractor dynamics.

6. Research Path

Phase 1: Proof of Concept

- Pilot experiments in text and sport (low-cost, existing data).
- Demonstrate reproducibility of κ .

Phase 2: Cross-Domain Validation

- Extend to neuroscience, engineering, biology.
- Compare κ stability across domains.

Phase 3: Theoretical Integration

- Relate κ to entropy, mutual information, and negentropy.
 - Position κ alongside established dimensionless ratios in science.
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7. Cultural Illustrations (Illustrative, not evidential)

- **Sport:** goals and tries as crystallized coherence.
- **Music:** rhythm as stabilized collective signal.
- **Ritual:** prayer or protest as coherence containers.

These serve as intuitive anchors for human recognition of coherence, but are not empirical evidence.

8. Closing Statement

We frame κ as a **candidate universal systems parameter**.

- It is measurable.
- It is falsifiable.
- It can be tested across domains.

The task is not to argue but to measure.

If κ stabilizes across recursive stress tests, coherence may prove to be a predictive invariant for

system stability — a cross-domain ratio with the significance of Reynolds number in fluid dynamics.