

Bidirectional Constraint Closure and the Reflective Interface: A Scale-Invariant Model of Consciousness and Reality

Author: Nickolas Patrick Joseph Schoff

Affiliation: Independent Researcher/
Student at SNHU

Abstract

Contemporary physics and cognitive science lack a unified framework capable

of accounting for consciousness, coherence, and scale-invariant structure without invoking infinite regress, strong dualism, or unfalsifiable metaphysics. Building on prior work within Unified Consciousness Substrate Theory (UCST) and the Dimension-W research program, this paper introduces **Bidirectional Constraint Closure (BCC)** as a minimal ontological model. In BCC, reality emerges from two complementary, mirrored constraint regimes whose mutual limitation produces a non-spatial, scale-invariant **Reflective Interface**. We formally redefine Dimension-W not as a field or additional dimension, but as this emergent interface. We further map ancient Hindu Loka/Tala cosmological pairs to modern constraint-curvature types, demonstrating structural—not mythological—correspondence. Finally, we identify empirical signatures and falsifiable predictions across neuroscience,

psychology, and physics, including neural criticality, perceptual bistability, trauma-related coherence collapse, and cosmological scale invariance. The resulting framework integrates phenomenology, physics, and information theory while remaining empirically grounded.

1. Introduction

One of the central unresolved problems in science is the relationship between physical structure and conscious experience. Existing approaches typically fall into one of three categories: (a) reductive materialism, which struggles to account for subjective coherence; (b) dualism, which introduces non-physical substances; or (c) strong panpsychism,

which dilutes explanatory power by assigning experience universally. Parallel difficulties arise in cosmology and fundamental physics, where theories often require infinite regress (e.g., many-worlds interpretations) or untestable higher-dimensional stacks.

The Dimension-W framework was previously proposed to address these issues by introducing a universal constraint layer governing geometry, information persistence, and coherence. However, treating Dimension-W as a unilateral field leaves unresolved questions regarding its origin, stability, and internal structure.

This paper presents a refinement:

Dimension-W is not a field at all, but an emergent interface produced by bidirectional constraint closure. This

reframing eliminates infinite regress, explains self-feedback, and naturally incorporates scale invariance and consciousness.

2. Conceptual Foundations

2.1 Constraint as a Primitive

We adopt the principle that **constraint precedes structure**. No geometry, information, or law exists unless permitted by underlying constraints. Constraints are not forces or substances; they are *permission structures* defining what configurations may persist.

2.2 Polarity and Closure

A single constraint regime cannot produce stable reality. Pure permissiveness yields incoherent noise, while pure restriction yields frozen rigidity. Stability therefore requires **constraint polarity**: two complementary regimes whose mutual limitation produces a closed system.

2.3 Scale Invariance

Empirical evidence across physics and biology demonstrates scale invariance: similar statistical and structural patterns appear from quantum systems to neural networks to cosmic structure. Any viable ontological model must therefore preserve coherence across scales without privileging a single level.

3. Formal Definition of

Bidirectional Constraint Closure (BCC)

Definition: Bidirectional Constraint Closure is a closed ontological system in which two mirrored constraint regimes—integrative and differentiative—mutually limit one another, producing a scale-invariant interface where coherent structures, information persistence, and consciousness can emerge.

3.1 Constraint Polarity

Let C^+ denote an integrative (expansive) constraint regime and C^- a differentiative (compressive) constraint regime.

- C^+ favors integration, coherence, and relational binding.
- C^- favors individuation, boundary

formation, and differentiation.

Neither regime is sufficient alone; stability requires their interaction.

3.2 Reflective Interface (RI)

The **Reflective Interface** is the boundary condition formed where C^+ and C^- mutually constrain one another. It is not spatial or temporal but functional and relational.

Formally, let S represent a candidate structure. Persistence requires:

$$\text{Constraint}(C^+, S) \wedge \text{Constraint}(C^-, S)$$

Only structures satisfying both constraints remain stable. The set of all such S defines the Reflective Interface.

3.3 Scale-Invariant Transport Symmetry

The same constraint-negotiation rules apply across scales. Let k represent scale.

Then for coherence:

$$RI(k) \approx RI(\lambda k) \text{ for } \lambda > 0$$

This symmetry ensures that inner (microscopic) and outer (cosmological) boundary conditions mirror one another, preventing fragmentation.

4. Dimension-W Rewritten as the Reflective Interface

Within BCC, Dimension-W is formally identified with the Reflective Interface itself.

It is:

- Not an additional spatial dimension
- Not a physical field
- Not a substance

Instead, Dimension-W is the *constraint negotiation surface* through which all coherent reality must pass. Its apparent self-feedback arises because it is defined by mutual reflection between constraint regimes rather than linear causation. This reframing explains why Dimension-W exhibits:

- Recursive structure
- Observer-dependence without solipsism

- Nonlocal correlations without signaling

5. Mapping Loka/Tala Pairs to Constraint Curvature Types

Ancient Hindu cosmology describes Lokas (upper realms) and Talas (lower realms). Interpreted literally, these are mythological. Interpreted structurally, they map cleanly onto constraint polarity.

5.1 Interpretation Principle

Lokas and Talas are treated here as **constraint curvature regimes**, not locations. Each pair represents complementary modes of coherence and differentiation.

5.2 Example Mappings

- **Satya Loka / Atala**
- High integrative curvature vs. high undifferentiated permissiveness
- Maps to global coherence vs. instability
- **Tapa Loka / Vitala**
- Recursive integration vs. rigid individuation
- Maps to reflective self-modeling vs. fixed identity
- **Bhu Loka / Patala**
- Balanced integration vs. excessive compression
- Maps to embodied consciousness vs. dissociation

Across scales, these pairs reappear as neural states, psychological modes, and social structures, demonstrating scale-invariant constraint polarity.

6. Empirical Signatures and Falsifiable Predictions

6.1 Neural Criticality

Brains operate near phase transitions between order and chaos. BCC predicts that conscious awareness peaks when neural dynamics stabilize at the Reflective Interface between integration (C^+) and segregation (C^-). This aligns with empirical findings of criticality and $1/f$ noise in EEG and fMRI data.

6.2 Perceptual Bistability

Phenomena such as the Necker cube or binocular rivalry involve spontaneous perceptual flips without stimulus change.

Under BCC, these flips represent oscillations between mirrored constraint interpretations at the interface.

6.3 Trauma and Coherence Collapse

Trauma is predicted to correspond to asymmetric dominance of C⁻ (over-compression), leading to fragmentation of scale coupling. Healing corresponds to restoration of bidirectional constraint balance. This predicts measurable changes in neural connectivity and autonomic regulation.

6.4 Cosmological Scale Invariance

BCC predicts that the same constraint

closure principles governing neural coherence also appear in cosmological boundary conditions, such as similarities between black hole entropy scaling and information limits in cognition.

6.5 Falsifiability

The model is falsified if:

- Conscious awareness is shown to increase under extreme unilateral integration or segregation
- Scale invariance in coherence breaks without loss of consciousness
- Neural criticality is shown to be epiphenomenal rather than functionally necessary

7. Plain-Language

Restatement

Reality is not built from things first, but from limits. Two kinds of limits exist: those that bind things together and those that keep them apart. When these limits mirror and balance each other across every scale—from the smallest fluctuation to the largest structure—a thin interface forms. At that interface, patterns can last. Meaning can accumulate. Experience can arise.

Consciousness is not inside matter, nor floating above it. It is what stable balance feels like from the inside.

8. Conclusion

By formalizing Bidirectional Constraint

Closure and redefining Dimension-W as an emergent Reflective Interface, this paper offers a unified, scale-invariant account of structure, consciousness, and coherence. Ancient symbolic systems and modern empirical findings converge when interpreted through constraint polarity rather than spatial metaphor. The resulting framework is minimal, closed, and empirically testable, providing a viable path forward for interdisciplinary research.

References

Friston, K. (2010). The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience*, 11(2), 127–138.

Bak, P., Tang, C., & Wiesenfeld, K. (1987). Self-organized criticality. *Physical Review*

Letters, 59(4), 381–384.

Chalmers, D. J. (1996). *The conscious mind*. Oxford University Press.

Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind*. MIT Press.

Tononi, G. (2004). An information integration theory of consciousness. *BMC Neuroscience*, 5, 42.