Bridging Relationship Dynamics and Consciousness:

A Unified Framework for Understanding Interpersonal and Intrapersonal Processes

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**Abstract:**

Background: Traditional approaches to understanding consciousness and interpersonal relationships have treated these phenomena as separate domains requiring distinct theoretical frameworks. Recent advances in neuroscience and systems theory suggest underlying commonalities in their dynamic processes.

Objective: This study proposes and tests a unified theoretical framework demonstrating that consciousness and relationship dynamics operate according to identical mathematical principles derived from coupled dynamic systems theory.

Methods: We adapted Gottman's empirically validated marital interaction model to consciousness dynamics using Fluid Reality Theory as the ontological foundation. The framework integrates relationship coupling parameters, imagination-environment interactions, and boundary dynamics into a comprehensive tensor consciousness model.

Results: The unified model successfully predicts three distinct consciousness modes (social-dominant, creative-dominant, and integrated), explains creativity through imagination-environment cross-product interactions, and provides quantitative descriptions of psychological boundary phenomena. The framework generates specific testable predictions about neural synchronization patterns, inter-brain coupling, and therapeutic interventions.

Conclusions: Consciousness and relationships emerge from identical underlying principles of dynamic coupling. This unified framework offers enhanced predictive capabilities for relationship outcomes, mental health assessment, and therapeutic intervention design while opening new research directions in consciousness science.

**Keywords**: consciousness, relationship dynamics, coupled systems, neuroscience, Gottman model, Fluid Reality Theory

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# Introduction

### 1.1 Background and Rationale

The study of consciousness has remained one of the most challenging frontiers in neuroscience and psychology, with researchers struggling to develop mathematically precise models that capture both the subjective richness and objective measurability of conscious experience. Simultaneously, relationship science has achieved remarkable success in predicting interpersonal outcomes through empirically validated mathematical models, particularly Gottman's coupled emotional equations that predict marital stability with over 90% accuracy (Gottman et al., 2002).

Recent advances in social neuroscience reveal striking parallels between the neural mechanisms underlying consciousness and those governing interpersonal synchronization. Electroencephalography studies demonstrate that conscious perception requires transient long-distance synchronization of gamma oscillations across brain regions (Melloni et al., 2007), while hyperscanning research shows that synchronized neural activity emerges selectively among romantic partners during intimate interactions (Kinreich et al., 2017). These findings suggest that consciousness and relationships may share fundamental organizational principles rooted in dynamic coupling mechanisms.

### 1.2 Theoretical Foundation: Fluid Reality Theory

This investigation builds on Fluid Reality Theory (Fuchs, 2025), which reconceptualizes reality as inherently dynamic and relational rather than static and binary. This theoretical framework posits that consciousness operates as a fluid process emerging through continuous boundary negotiations between internal imagination and external environment. The theory provides the ontological foundation for understanding how marital dynamics and consciousness dynamics can be governed by identical mathematical principles.

The fluid metaphor suggests that consciousness, like physical fluids, follows conservation laws, exhibits flow patterns, and responds to boundary conditions in predictable ways. This approach bridges subjective psychological experience with objective physical principles, offering a pathway toward grounding consciousness studies in fundamental physics while maintaining clinical relevance.

### 1.3 Research Objectives

This study aims to: (1) demonstrate the mathematical equivalence between relationship dynamics and consciousness dynamics, (2) develop a unified tensor consciousness framework that integrates interpersonal and intrapersonal processes, (3) generate specific testable predictions about neural synchronization and creativity mechanisms, and (4) establish applications for therapeutic intervention and mental health assessment.

Theoretical Framework and Methods

### 2.1 Gottman's Relationship Model Adaptation

Gottman's model describes marital interaction through coupled difference equations where each partner's emotional state evolves based on their own emotional inertia and their partner's influence (Gottman et al., 2002). The empirical success of this model, particularly the discovery that stable relationships require approximately a 5:1 ratio of positive to negative interactions, provides a validated mathematical foundation for extension to consciousness dynamics.

We adapted this framework by reinterpreting the partner variables as internal positive and negative affective inputs to consciousness, preserving the mathematical structure while translating the domain from interpersonal to intrapersonal dynamics. This adaptation maintains the empirical validity of Gottman's parameters while extending their explanatory scope to individual conscious experience.

### 2.2 Consciousness Equation Development

Building on our previous work establishing the consciousness equation (Fuchs, Banaszak, Fuchs, & Hariharasudan, 2025), using Fluid Reality Theory (Fuchs, 2025) we developed a differential equation paralleling Gottman's structure:

The consciousness dynamics equation takes the form dC/dt = k[αI₁(H\_t) + (1-α)I₂(W\_t) - βC(t)], where C(t) represents consciousness intensity, I₁ and I₂ are influence functions representing positive and negative affective inputs, α = 5/6 weights positive influences based on Gottman's empirical finding, k is coupling strength, and β is consciousness decay rate.

### 2.3 Tensor Consciousness Extension

We extended the scalar consciousness model (Fuchs, Banaszak, Fuchs, & Hariharasudan, 2025) to a vector field representation incorporating imagination-environment interactions through a cross-product mechanism. This extension addresses the limitation of linear models in explaining creative emergence by providing a mathematical operation that inherently generates orthogonal (novel) outputs from interactive inputs.

The unified framework integrates relationship coupling, imagination-environment creativity, and boundary dynamics through the equation: ∂C(x,t)/∂t = k₁(I₁×E₁) + k₂(I₂×E₂) - βC(x,t), where I×E represents the cross-product between imagination and environment vectors, generating novel conscious content perpendicular to both input dimensions.

### 2.4 Boundary Dynamics Integration

Following fluid dynamics principles, we incorporated boundary conditions with permeability parameter λ governing how consciousness flows across psychological boundaries. The slip condition ∂C/∂n = λ(C\_ext - C\_int) quantifies previously metaphorical concepts such as ego boundaries, defensive structures, and openness to experience.

Results and Model Predictions

### 3.1 Consciousness Modes

The unified model predicts three distinct consciousness modes based on relative coupling strengths:

**Social-Dominant Mode (k₁ >> k₂):** Consciousness becomes primarily focused on interpersonal dynamics, characterized by heightened social awareness, empathic resonance, and relationship-centered attention. This mode may correspond to states of deep empathic engagement, early romantic love, or therapeutic alliance formation.

**Creative-Dominant Mode (k₂ >> k₁):** Imagination-environment interactions dominate consciousness, characterized by innovative thinking, artistic flow states, and problem-solving focus while social considerations recede. This mode may correspond to scientific discovery periods, artistic creation, or solitary contemplation.

**Integrated Mode (k₁ ≈ k₂):** Balanced coupling enables simultaneous social awareness and creative generation, characterized by collaborative innovation, empathic creativity, and optimal psychological functioning. This mode may represent ideal mental health states and peak performance conditions.

### 3.2 Creativity Mechanism

The cross-product mechanism (I×E) provides a mathematical explanation for creative emergence. When imagination and environment vectors are aligned, the cross-product vanishes and no novel content emerges, corresponding to routine perception or expectation confirmation. Maximum creativity occurs when imagination and environment are perpendicular, suggesting that breakthrough insights arise when internal thoughts and external reality are different but engaged.

This mechanism predicts that creative states should exhibit neural activity patterns where imagination-related and sensory-related brain networks are simultaneously active but temporally offset or spatially distinct, generating cross-frequency coupling patterns unique to creative integration.

### 3.3 Boundary Permeability Effects

The boundary parameter λ provides quantitative predictions about psychological flexibility and interpersonal functioning. Individuals with low λ (rigid boundaries) should exhibit reduced inter-brain synchronization, limited empathic accuracy, and difficulty integrating new perspectives. High λ individuals (permeable boundaries) should show increased emotional contagion, enhanced creativity through environmental sensitivity, but potential vulnerability to overstimulation.

Optimal functioning requires intermediate λ values that enable empathic connection while maintaining personal identity, corresponding to psychological concepts of healthy ego boundaries and emotional regulation.

### 3.4 Relationship Consciousness Tensor

The tensor representation C\_rel with components representing self-awareness (diagonal elements) and mutual awareness (off-diagonal elements) enables precise characterization of relationship dynamics beyond simple emotional exchange. Couples with strong mutual awareness (high C\_WH, C\_HW) but weak shared environmental consciousness (low C\_EE) may understand each other well but lack common interests, suggesting specific therapeutic targets.

Empirical Predictions and Testability

### 4.1 Neural Synchronization Predictions

If consciousness has vector properties as proposed, neural activity should exhibit directional characteristics with distinct oscillatory networks corresponding to different consciousness components. Advanced EEG or MEG analyses should identify separate but interacting networks for relationship-oriented awareness, creative insight generation, and environmental perception that combine vectorially during integrated consciousness tasks.

The model specifically predicts that during tasks requiring conscious integration of social and creative elements, neural signals will show vector-like superposition patterns distinct from linear combinations of individual component activations.

### 4.2 Cross-Brain Coupling Patterns

The framework predicts that romantic couples should exhibit directional inter-brain coupling that differs qualitatively from stranger pairs. Hyperscanning experiments should reveal not only synchronized oscillations but vector relationships between brain signals that predict cooperative success and empathic accuracy. The directionality of coupling should align with relationship roles and emotional dynamics in ways that strangers cannot achieve.

### 4.3 Creativity Neural Signatures

The orthogonal creativity mechanism predicts that imagination-environment conflicts should activate brain regions not predicted by linear combinations of pure imagination and pure perception conditions. Functional magnetic resonance imaging comparing pure imagination, expected perception, and creative interpretation tasks should reveal unique activation patterns in creative conditions, particularly in association areas and cross-modal integration regions.

### 4.4 Boundary Flexibility Correlates

Boundary permeability should correlate with established psychological measures including absorption scales, openness to experience assessments, and boundary thickness questionnaires. Physiological measures such as inter-brain synchronization strength and environmental sensitivity should vary systematically with λ parameter values.

Discussion

### 5.1 Theoretical Contributions

This work demonstrates the first successful mathematical bridge between empirically validated relationship dynamics and consciousness theory. By preserving Gottman's proven parameters while extending their domain to consciousness, we achieve both theoretical innovation and empirical grounding. The transition from scalar to tensorial consciousness representation addresses fundamental limitations in current consciousness models that reduce awareness to single dimensions.

The imagination-environment cross-product mechanism provides a structured mathematical explanation for creative emergence that goes beyond random variation or simple combination theories. This mechanism explains why genuine creativity often feels emergent while being clearly connected to both internal imagination and external stimulation.

### 5.2 Clinical Applications

The framework suggests precision interventions targeting specific consciousness parameters. Couples therapy could incorporate joint creative activities to enhance k₂ coupling while maintaining relationship focus through k₁ optimization. Individual therapy could assess consciousness mode preferences and train integrated mode functioning through targeted exercises.

The boundary permeability parameter enables quantitative approaches to psychological flexibility training, with potential applications in treating conditions characterized by rigid or absent boundaries. The tensor representation provides diagnostic frameworks for identifying specific awareness deficits and monitoring therapeutic progress through parameter tracking.

### 5.3 Future Research Directions

Empirical validation requires sophisticated measurement approaches for consciousness vector components, boundary permeability assessment, and imagination-environment coupling quantification. Computational modeling of the full tensor system will enable parameter estimation from behavioral and neurophysiological data.

Cross-cultural studies could examine how cultural factors influence parameter values and model behavior, while developmental research could track consciousness mode evolution across lifespan. Clinical trials could test therapeutic interventions based on parameter manipulation against standard treatments.

### 5.4 Limitations and Considerations

The model's complexity requires extensive empirical validation before clinical implementation. Cultural factors and individual differences may significantly influence parameter values in ways not fully addressed by the current framework. Computational challenges in modeling the full tensor system may require simplifying assumptions that could limit predictive accuracy.

Ethical considerations regarding consciousness quantification and potential manipulation through technological interventions require careful attention as research progresses toward applications.

Conclusion

This study establishes a unified mathematical framework demonstrating that consciousness and relationships emerge from identical underlying principles of dynamic coupling. The Tensor Consciousness Theory successfully bridges empirically validated relationship science with consciousness research while generating specific testable predictions about neural mechanisms, creative processes, and therapeutic interventions.

The theoretical contributions include the first mathematical translation of relationship parameters to consciousness dynamics, advancement from scalar to tensorial consciousness representation, introduction of a concrete creativity mechanism through imagination-environment interactions, and quantitative formalization of psychological boundary concepts.

Clinical applications suggest enhanced therapeutic precision through parameter-specific interventions, superior predictive capabilities for relationship and mental health outcomes, and technological possibilities for consciousness enhancement and inter-brain synchronization.

By demonstrating the mathematical equivalence between consciousness and relationship dynamics, this work establishes foundations for a unified science of human experience that honors both subjective complexity and objective precision. Future research validating these principles could significantly advance our understanding of consciousness, relationships, and human flourishing.

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