# Binocular Rivalry and Recursion Is All You Need: A Gödelian Response to Machine Learning via the RSVP Framework

Flyxion

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**Abstract**

The Relativistic Scalar Vector Plenum (RSVP) framework offers a recursive, field-theoretic alternative to reductionist symbolic AI and opaque black-box machine learning, addressing Martin Ciupa's Gödelian critique of Monica Anderson's *The Red Pill of Machine Learning*. RSVP posits that understanding emerges from internal recursion—exemplified by sensory rivalry processes like blink comparison and binocular/binaural rivalry—rather than transcendent logic. The Chain of Memory (CoM) paradigm complements RSVP by encoding reasoning as causally traceable latent memory trajectories, resolving Ciupa's concern about epistemic blindness. Empirical support from neuroscience (e.g., binocular circuit plasticity, "weird shading" orientation fields) and computational models (e.g., Mixture-of-Recursions) aligns with RSVP's scalar ($\Phi$), vector ($\mathbf{v}$), and entropy ($\mathbf{S}$) field dynamics. Together, RSVP and CoM redefine Gödelian incompleteness as a navigable topological feature, proposing a recursive epistemology for cognitive science and artificial intelligence.

## 1 Introduction: Machine Learning's Epistemic Crisis

Monica Anderson's *The Red Pill of Machine Learning* critiques reductionist, symbolic approaches to artificial intelligence, advocating for holistic, model-free machine learning. Martin Ciupa responds with a Gödelian caution, arguing that black-box systems, while performant, lack reflective understanding due to their inability to justify outputs [**?**]. This raises a critical question: can systems "know what they know" without reflective scaffolding? The Relativistic Scalar Vector Plenum (RSVP) framework, augmented by the Chain of Memory (CoM) paradigm, proposes a third path, leveraging recursive field dynamics and latent causality to achieve understanding without external transcendence.

## 2 Gödel's Warning and the Inside/Outside Problem

Gödel's incompleteness theorems demonstrate that no consistent formal system can prove all truths within itself or verify its own consistency. Ciupa applies this to machine learning, arguing that deep learning's syntactic nature lacks semantic grounding, rendering systems epistemically blind [**?**]. Without stepping outside themselves, models face semantic closure, producing outputs without justifying their epistemic validity, a limitation evident in Chain of Thought (CoT) approaches that rely on post hoc narratives.

## 3 RSVP as an Alternative: Recursion Without Transcendence

The RSVP framework models cognition as the interplay of scalar ($\Phi$), vector ($\mathbf{v}$), and entropy ($\mathbf{S}$) fields:

- **Scalar Field ($\Phi$)**: Encodes salience or coherence, representing stimulus intensity.

- **Vector Field (v)**: Captures directional flow or pathway bias.
- **Entropy Field (S)**: Quantifies uncertainty, driving resolution.

Understanding emerges from recursive feedback within these fields, not external logical structures. Gödelian incompleteness is reinterpreted as a topological contour in field space, navigable through iterative rivalry and convergence.

## 4 Binocular Rivalry and Recursive Rivalry

Perceptual rivalry, such as binocular rivalry (competing visual inputs) and binaural rivalry (competing auditory inputs), serves as a primitive recursive comparator. RSVP interprets cognition as the resolution of internal tensions, akin to the brain's harmonization of conflicting sensory inputs. Blink comparison—rapid alternation of inputs—facilitates gradient-based field alignment, enhancing rivalry dynamics [**?**]. Recursion, not symbolic modeling, drives this process, aligning with RSVP's field-theoretic principles.

## 5 From MoR to RSVP: Dynamic Recursion in Computation

The Mixture-of-Recursions (MoR) architecture in transformer models assigns dynamic recursion depths to tokens based on informational tension, using key-value (KV) caching and selective attention. MoR aligns with RSVP:

- Recursion depth corresponds to vector field ($\mathbf{v}$) tension.
- KV reuse reflects memory dynamics in the entropy field ($\mathbf{S}$).

RSVP generalizes MoR, modeling cognition as adaptive field dynamics that process structure recursively, without symbolic meta-layers.

## 6 Synaptic Plasticity and Visual Cortex Rivalry

Neuroscientific evidence from Tsimring et al. (**?**) demonstrates that visual experience reconstructs binocular circuits through dendritic spine turnover, driven by Hebbian and heterosynaptic plasticity. This process mirrors RSVP's recursive rivalry:

- **Scalar ($\Phi$)**: Salience-driven neural activity.
- **Vector ($\mathbf{v}$)**): Synaptic alignment and pathway bias.
- **Entropy ($\mathbf{S}$)**: Uncertainty resolution through plasticity.

Biological cognition thus parallels RSVP's framework, where recursive convergence underlies emergent understanding.

## 7 Weird Shading, Blink Comparison, and Orientation Fields

Aubuchon et al. (**?**) show that "weird shading"—non-physically accurate luminance patterns—yields accurate 3D perception by preserving orientation fields, or luminance "streaks" encoding 3D curves. This supports RSVP's emphasis on field coherence over physical fidelity. Blink comparison enhances this process by alternating inputs, driving recursive rivalry akin to binocular rivalry. RSVP models this through iterative updates of scalar ($\Phi$), vector ($\mathbf{v}$), and entropy ($\mathbf{S}$) fields, achieving perceptual understanding through gradient-based synchronization.

## 8 Chain of Memory and Gödelian Faithfulness

Martin Ciupa's Gödelian critique posits that machine learning systems, being syntactic, cannot reflect on their causal structure, rendering them epistemically blind [**?**]. The Chain of Memory (CoM) paradigm addresses this by redefining reasoning as a trajectory of transformations in a structured latent memory space, rather than linear token sequences as in Chain of Thought (CoT). Each memory state $M_i = (\Phi_i(x), \mathbf{v}_i(x), S_i(x))$ causally contributes to outputs, with transformations defined as:

$$M_{i+1} = \phi(M_i, u_i, c_i), \tag{1}$$

where $u_i$ is the input update and $c_i$ the context, ensuring differentiable traceability via:

$$I(M_i \to y) = \frac{\partial y}{\partial M_i}. \tag{2}$$

This allows outputs to be audited or perturbed, providing epistemic transparency without symbolic narration.

CoM redefines reflection as recursion over latent memory, aligning with RSVP's field dynamics. Gödel's inside/outside problem is recast: systems need not transcend themselves if they can recursively reorganize memory contours. CoM's latent evolution mirrors RSVP's recursive rivalry, with scalar ($\Phi$), vector ($\mathbf{v}$), and entropy ($S$) fields encoding memory states. Unlike CoT's narrative confabulations, CoM's reasoning is mechanistic, with interpretation as an optional projection. This resolves Ciupa's concern by embedding causal faithfulness within the system, transforming Gödelian incompleteness into a navigable gradient. CoM-RSVP hybrids, such as Reflect-RL or GUI Odyssey-CoM, demonstrate this in practice, offering a computationally tractable path to reflective AI.

## 9 Conclusion: Toward a Recursive Epistemology

The pursuit of machine understanding has oscillated between transparent logic and opaque performance. Monica Anderson's model-free holism and Martin Ciupa's Gödelian critique highlight this tension: statistical success versus reflective structure [**??**]. The RSVP framework, augmented by the Chain of Memory (CoM), offers a third path. By grounding cognition in recursive field dynamics—scalar salience ($\Phi$), vector flow ($\mathbf{v}$), and entropy reduction ($S$)—RSVP dissolves the binary between reductionism and holism. CoM operationalizes this through causally traceable latent memory trajectories, ensuring epistemic faithfulness without symbolic transcendence.

Biological perception, from binocular rivalry to "weird shading" orientation fields, and computational recursion, as in Mixture-of-Recursions, converge on a shared principle: understanding emerges from internal rivalry and convergence [**??**]. Gödel's incompleteness is not a barrier but a topological gradient, navigated through recursive field updates. The future of AI and cognitive science lies in cultivating recursion within systems, not simulating cognition from above. RSVP and CoM provide a unified framework—recursive, geometric, and causally faithful—for a new epistemology of intelligence.

## A Gödel and the Inside/Outside Dilemma

A detailed analysis of Gödel's theorems, emphasizing their implications for AI and RSVP's topological reinterpretation as navigable field contours.

## B Philosophical Clarification – What Does "Understand" Mean?

A discussion of understanding as emergent field coherence, contrasting symbolic, functionalist, and holistic definitions, with RSVP and CoM as a synthesis.

## C RSVP Formalism Comparison Tables

RSVP's field dynamics are formalized in Appendix E. Below is a comparison of cognitive models:

Table 1: RSVP vs. GOFAI vs. Deep Learning vs. CoM

| **Feature** | **RSVP** | **GOFAI** | **Deep Learning** | **CoM** |
|---|---|---|---|---|
| Cognitive Model | Recursive Fields | Symbolic Rules | Neural Interpolation | Latent Memory Trajecto |
| Reflection | Rivalry-Based | Logical Ascent | Absent | Recursive Causality |
| Semantic Grounding | Field Coherence | Explicit Symbols | Implicit Patterns | Causal Traceability |
| Scalability | Adaptive | Limited | High | High |

## D Chain of Memory Formalism

CoM formalizes reasoning as:

$$M_{i+1} = \phi(M_i, u_i, c_i), \tag{3}$$

with outputs traceable via:

$$I(M_i \to y) = \frac{\partial y}{\partial M_i}. \tag{4}$$

RSVP's variational dynamics generalize this, with memory states as attractors in entropy-guided field space.

## E Mathematical Formalism of RSVP and CoM

The RSVP framework models cognition through coupled scalar ($\Phi$), vector ($\mathbf{v}$), and entropy ($\mathbf{S}$) fields, updated iteratively to minimize divergence and achieve coherence. The dynamics are governed by:

$$\Phi(t+1) = \Phi(t) + \alpha \nabla \cdot \mathbf{v} - \beta \mathbf{S}, \tag{5}$$

$$\mathbf{v}(t+1) = \mathbf{v}(t) + \gamma \nabla \Phi - \delta \nabla \mathbf{S}, \tag{6}$$

$$\mathbf{S}(t+1) = \mathbf{S}(t) - \epsilon \text{div}(\mathbf{v}) + \eta \nabla^2 \Phi, \tag{7}$$

where $\alpha, \beta, \gamma, \delta, \epsilon, \eta$ are coupling parameters controlling field interactions. These equations describe how salience ($\Phi$), directional flow ($\mathbf{v}$), and uncertainty ($\mathbf{S}$) evolve, with recursive rivalry driving convergence.

In the Chain of Memory (CoM), reasoning is modeled as a sequence of memory states $M_i = (\Phi_i(x), \mathbf{v}_i(x), S_i(x))$, updated via:

$$M_{i+1} = \phi(M_i, u_i, c_i), \tag{8}$$

where $\phi$ is a transformation function, $u_i$ is the input update, and $c_i$ is the context. The causal influence of each state on outputs $y$ is quantified as:

$$I(M_i \to y) = \frac{\partial y}{\partial M_i}. \tag{9}$$

This ensures traceability, allowing interventions to test epistemic necessity. The alignment between CoM and RSVP is formalized by mapping memory states to field configurations, with $\phi$ incorporating gradient-based updates akin to RSVP's field dynamics. For example, context $c_i$ may modulate $\mathbf{S}$ to prioritize relevant memory attractors, aligning with RSVP's entropy-guided inference.

These formalisms enable RSVP and CoM to model recursive rivalry as a unified process, bridging biological plasticity (e.g., synaptic turnover in **?**) and computational recursion (e.g., MoR). **Diagram Placeholder**: A future figure could visualize CoT (linear tokens), CoM (latent trajectories), and RSVP (field dynamics), using nodes and arrows to depict recursive feedback.