Autoregressive Cognition and RSVP Dynamics: A Thermodynamic Reinterpretation

Anonymous

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Abstract

This paper integrates the Rapid Serial Visual Presentation (RSVP) paradigm with autoregressive cognition, reinterpreted through long-range dependency (LRD) frameworks and Cecilia Payne-Gaposchkin's thermodynamic principles. By synthesizing the TARTAN framework, Simulated Agency, entropy smoothing, and Cyclex models, we propose a non-Markovian model of cognitive processing that aligns with thermodynamic constraints. A novel reinterpretation of RSVP as an autoregressive process is presented, contrasting traditional modal storage models. We discuss implications for cognitive science and astrophysical analogies, emphasizing entropy-driven dynamics.

1 Introduction

The Rapid Serial Visual Presentation (RSVP) paradigm **?** has been a cornerstone in understanding human cognitive processing, particularly in attention and memory. Recent advances in autoregressive cognition **?** and long-range dependency (LRD) models **?** suggest a reinterpretation of RSVP as a non-Markovian process. By integrating Cecilia Payne-Gaposchkin's thermodynamic paradigm **?**, this work proposes a unified framework that connects cognitive dynamics to entropy-driven systems. Our approach builds on prior frameworks, including TARTAN, Simulated Agency, entropy smoothing, and Cyclex, to model cognition as a thermodynamically constrained autoregressive process.

2 Autoregressive Cognition and RSVP

Traditional models of RSVP assume modal storage, where information is processed and stored in discrete, independent units **?**. In contrast, autoregressive cognition posits that cognitive states evolve through sequential dependencies, leveraging past states to predict future ones **?**. This aligns with LRD models, which emphasize non-Markovian dynamics in complex systems **?**. By reinterpreting RSVP through this lens, we propose that visual stimuli are not processed in isolation but as part of a continuous, history-dependent stream.

2.1 Thermodynamic Foundations

Payne-Gaposchkin's thermodynamic paradigm **?** provides a novel lens for cognitive modeling. By treating cognitive processes as thermodynamic systems, we can apply principles of entropy and energy dissipation. Entropy smoothing, as introduced in prior work, mitigates information overload by redistributing cognitive load across temporal dependencies. This aligns with Payne-Gaposchkin's insight that systems evolve toward equilibrium through constrained energy transfers.

3 Integration with Prior Frameworks

Our model synthesizes several frameworks:

- **TARTAN**: A temporal-attention framework that prioritizes salient features across time **?**.
- **Simulated Agency**: A model of decision-making under uncertainty, incorporating predictive coding **?**.
- **Entropy Smoothing**: A mechanism to reduce cognitive entropy spikes **?**.
- **Cyclex**: A cyclical model of iterative learning and adaptation **?**.

These frameworks collectively support a non-Markovian reinterpretation of RSVP, where

cognitive states are dynamically shaped by past inputs and thermodynamic constraints.

4 Modal Storage vs. Autoregressive Dynamics

Figure 1: Contrast between (a) modal storage, where information is processed in discrete units, and (b) autoregressive RSVP dynamics, characterized by history-dependent, non-Markovian processing.

Figure 1 illustrates the distinction between traditional modal storage and our proposed autoregressive RSVP dynamics. While modal storage assumes independence between cognitive units, autoregressive dynamics emphasize temporal dependencies, aligning with LRD and thermodynamic principles.

5 Discussion

The integration of autoregressive cognition with RSVP and thermodynamic principles offers a novel perspective on cognitive processing. By moving beyond Markovian assumptions, our model captures the complexity of human attention and memory in dynamic environments. The thermodynamic analogy further suggests that cognitive systems, like astrophysical systems, are governed by entropy-driven constraints, providing a unifying framework for interdisciplinary research.

6 Conclusion

This paper presents a reinterpretation of RSVP through autoregressive cognition, LRD, and thermodynamic principles. By synthesizing TARTAN, Simulated Agency, entropy smoothing, and Cyclex, we propose a non-Markovian model that bridges cognitive science and astrophysical theory. Future work should explore empirical validation of these dynamics and their implications for artificial intelligence and cognitive modeling.