

# The Song That Doesn't End: On Recursive Propagation in Memes, Waves, and Autocatalytic Systems

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## Abstract

This essay explores the structural commonality underlying seemingly disparate systems: viral memes, electromagnetic waves, and collectively autocatalytic chemical sets. Each exhibits self-propagation through internal recursion or mutual generation. We argue that such systems constitute a general class of self-sustaining processes whose continuity is ensured not by external validation or utility but by structural features that favor their own persistence. This analysis situates memetic survival within a broader epistemic and physical ontology, suggesting that language, cognition, and even physical forces participate in a deeper recursive logic. Extensions to biological, economic, social, and political systems, along with empirical and philosophical implications, further illuminate this unifying pattern.

## 1 Introduction: The Infinite Song

The children's tune *The Song That Doesn't End* encapsulates a recursive loop: each line instructs the singer to continue, embedding the imperative for perpetuation within its own structure. Far from a trivial amusement, this song exemplifies a broader class of systems—memes, electromagnetic waves, and autocatalytic chemical sets—that persist through internal recursion or mutual generation. Language, often described as a cognitive “infection” that restructures human thought to propagate itself (2), serves as a paradigmatic case. This essay argues that such systems share a structural logic: they encode instructions or dynamics that ensure their own continuity, independent of external truth or utility. By examining memetic persistence, electromagnetic wave propagation, autocatalytic chemical networks, and additional domains like biology and economics, we propose a unified framework for self-propagating systems, with implications for understanding language, cognition, and epistemology.

## 2 Memetic Persistence and the Counterfoil Stub

In memetics, ideas replicate through culture not because they are true or useful but because they are replicable (3). Memes that endure often possess qualities such as rhythm, emotional salience, recursion, or self-reference. The metaphor of the “counterfoil stub”—a receipt saved because it declares “Do not throw this away”—captures this dynamic. Similarly, the Kalabari cultural practice of offering a “counterfoil choice” (e.g., an empty bowl alongside a full one) highlights a preferred option through contrast (21). In memetic terms, seemingly inferior or false ideas, such as “forbidden” memes that instruct “Don’t share this,” may persist by leveraging curiosity, exclusivity, or social signaling. These memes thrive not despite their prohibition but because it amplifies their allure, creating a paradox where disobedience ensures propagation. For example, phrases like “I’m not supposed to tell you this, but...” embed a transgression engine, ensuring their spread through violation of their own instructions. This suggests that memetic survival often hinges on structural features—stickiness, contrast, or provocation—rather than epistemic validity.

## 3 Electromagnetic Waves as Recursive Fields

Electromagnetic (EM) radiation, as described by Maxwell’s equations, exemplifies mutual recursion in physical systems (11). A changing electric field induces a magnetic field, which in turn induces an electric field, resulting in a self-propagating wave that persists through space without external intervention. This dynamic mirrors memetic loops: once initiated, the wave’s structure ensures its continuation, akin to a meme that regenerates interest through responses it elicits. The recursive interplay of electric and magnetic fields requires no external validation, much like a viral slogan that spreads through its own salience. This analogy highlights a shared logic: systems that propagate by generating the conditions for their own continuity.

## 4 Autocatalytic Sets and Chemical Cognition

Stuart Kauffman’s theory of collectively autocatalytic sets describes chemical systems where molecules catalyze the formation of others within the same set, creating a self-sustaining network (8). These sets exhibit structural closure, requiring no external intervention once initiated, and propagate by creating favorable conditions for their own persistence. Proposed as prebiotic precursors to life, autocatalytic sets share structural parallels with memetic networks and language, where ideas or grammatical rules mutually reinforce each other. For instance, a linguistic system sustains itself through recursive definitions and syntactic loops, much like a chemical network perpetuates through catalytic cycles. This suggests that cognition itself may operate as an autocatalytic system, with ideas persisting through mutual enablement rather than centralized control.

## 5 Toward a General Theory of Self-Propagation

The systems discussed—memes, EM waves, and autocatalytic sets—share four key criteria:

1. **Recursive Causation:** Outputs feed back into inputs, creating self-reinforcing loops.
2. **Mutual Generation:** Elements produce each other across structural boundaries, as in electric and magnetic fields or catalytic networks.
3. **Persistence Through Internal Logic:** Continuity depends on structural features, not external validation.
4. **Resistance to Termination:** Attempts to halt these systems often reinforce their propagation, as seen in earworms or forbidden memes.

These criteria define a general class of self-propagating systems, applicable across cognitive, physical, and chemical domains. For example, the Zettelkasten note-taking system, with its interconnected entries, resembles a memetic autocatalytic set, where ideas persist through recursive linking rather than inherent truth (9).

### 5.1 Formalizing Recursive Propagation

To formalize this framework, consider recursive causation as a dynamical system  $\dot{x} = f(x, t) + g(x, t)$ , where  $g(x, t)$  represents feedback from prior states, modeling loops like those in *The Song That Doesn't End* (19). Resistance to termination can be quantified via Lyapunov stability, where a system's fixed points have negative eigenvalues ( $\lambda < 0$ ), ensuring persistence against perturbations (22). Connections to complexity theory highlight emergent behavior in self-organizing systems (5), while cybernetics emphasizes feedback loops (22), and systems theory explores autopoiesis (10). These frameworks provide rigorous metrics for analyzing self-propagation, grounding the essay's conceptual unity in mathematical and theoretical terms.

### 5.2 Empirical Approaches to Recursive Propagation

Empirical validation of this framework requires testing the four criteria. Experiments could measure memetic persistence by comparing structural features (e.g., rhythm, emotional salience) against truth value, using metrics like share rates or retention time in social media datasets (23). Analysis of viral content could identify patterns like recursion or self-reference, leveraging computational memetics (4). Neuroimaging studies could explore neural correlates of earworms, examining how recursive cognitive loops activate reward circuits (17). These approaches would test the hypothesis that structural features drive propagation independent of epistemic merit.

## 6 Additional Domains of Recursive Propagation

The recursive logic extends beyond memes, waves, and chemical sets to other domains, reinforcing the framework’s universality.

### 6.1 Biological Systems

Viruses, prions, and cancer cells exhibit recursive propagation. For example, viral proteins act as “counterfoil stubs,” ensuring replication by hijacking cellular machinery (8). Prions propagate by inducing misfolding in other proteins, a recursive loop akin to memetic spread. Cancer cells sustain growth through autocatalytic signaling pathways, mirroring the mutual generation criterion.

### 6.2 Economic Systems

Ponzi schemes and cryptocurrency hype cycles operate as autocatalytic financial loops. In Ponzi schemes, early payouts catalyze further investment, creating a self-reinforcing cycle until collapse (18). Cryptocurrency markets propagate through speculative feedback, where hype generates more hype, aligning with the essay’s criteria of mutual generation and internal persistence.

### 6.3 Social Media Algorithms

Recommendation algorithms create recursive content loops by amplifying attention to salient items, forming echo chambers that mirror memetic propagation (1). These systems exhibit resistance to termination, as user engagement reinforces algorithmic bias, sustaining loops without external validation.

### 6.4 Political Movements

Ideological frameworks, such as populist narratives, persist through recursive reinforcement and contrastive framing (e.g., “us vs. them” as a Kalabari counterfoil choice). These movements propagate by embedding instructions for their own continuation, leveraging emotional salience and social identity (13).

## 7 Philosophical Dimensions of Recursive Systems

The recursive framework raises profound philosophical questions. The tension between structural persistence and epistemic value challenges traditional notions of truth-seeking: if cognition prioritizes stickiness over validity, what distinguishes meaningful ideas from mere earworms? This suggests a view of cognition as an autocatalytic arena, where agency competes

with recursive loops, potentially undermining free will (6). Connections to Buddhist dependent origination, where phenomena co-arise through mutual causation (14), and Hindu cyclical time (samsara) (20), situate the framework in global philosophical traditions, highlighting recursion as a universal principle of existence.

## 7.1 Historical Perspectives on Recursive Propagation

Historically, recursive systems are evident in persistent cultural practices. Oral storytelling traditions embed recursive structures (e.g., repeated motifs in epics) that ensure transmission across generations (15). Religious dogmas propagate through self-referential doctrines, akin to counterfoil stubs. Technological shifts, such as the printing press or internet, alter the substrates for recursive systems, amplifying their reach while preserving their logic (12).

# 8 Implications for Cognition and Language

Language may be viewed as a self-perpetuating system, akin to an autocatalytic set or EM wave, where recursive grammars, memetic selection, and cognitive “earworms” ensure continuity. The Zettelkasten method, recursive AI prompts, and viral slogans illustrate this: ideas survive because they replicate, not because they clarify. The metaphor of language as a cognitive “infection” (2) is evocative but risks tautology, as any replicating system (e.g., gravity, chemistry) could be labeled an infection. Instead, we propose that cognition is an arena for competing recursive systems, where memes, like *The Song That Doesn’t End*, persist through structural stickiness rather than epistemic merit.

## 8.1 Applications of Recursive Propagation

Insights from this framework can inform practical applications. Beneficial recursive systems, such as educational memes or public health campaigns, can leverage stickiness (e.g., catchy slogans for vaccination drives) to ensure propagation (16). “Circuit breakers” for harmful loops, such as algorithmic interventions to disrupt social media echo chambers, can mitigate recursive amplification (1). Knowledge management systems can evolve beyond Zettelkasten by balancing persistence with epistemic rigor, using structured curation to filter out “epistemic earworms.”

# 9 Conclusion: Escaping the Loop or Listening Closely

Self-propagating systems—whether memes, waves, chemical networks, or social movements—reveal a unifying principle: persistence through recursive structure. While we may critique such systems as epistemically hollow, their elegance lies in their ability to sustain themselves across

diverse substrates. The challenge is distinguishing systems that perpetuate meaning from those that merely perpetuate themselves. As we hum along to *The Song That Doesn't End*, we must ask: Are we trapped in a cognitive loop, or are we learning to hear its structure? Recognizing the recursive core empowers us to navigate their influence, whether in language, cognition, or the physical world.

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