Attentional Cladistics: A Theory of Recursive Perceptual Selection in Biological and Cultural Evolution

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Toward a Relativistic Scalar-Vector Field Theory of Meaning and Self-Domestication

Abstract

This paper introduces **attentional cladistics**, a novel framework positing that evolutionary lineages—biological, cultural, or technological—are shaped not only by descent with modification but also by recursive patterns of attention, care, and perceptual selection. In contrast to traditional cladistics, which tracks material inheritance such as genes or artifacts, attentional cladistics emphasizes the salience of traits within intersubjective perception fields that guide selection pressures. We integrate this concept into the **Relativistic Scalar Vector Plenum (RSVP)** theory, which models attention and care as vector fields, meaning as scalar salience fields, and entropy as a modulator of uncertainty. This framework provides a dynamic account of evolution, where traits persist or fade based on their recursive coupling to attentional flows. The RSVP model unifies phenomena such as self-domestication, cultural evolution, infant-care dynamics, and the stabilization of meaning across generations, offering a field-theoretic perspective on evolutionary processes (Tinbergen, 1951; Tomasello, 2019; Doctor et al., 2022).

Contents

1 Introduction

Attentional cladistics redefines evolutionary analysis by emphasizing the recursive dynamics of perceptual selection over traditional material inheritance. Traditional cladistics, rooted in phylogenetic analysis, traces lineages through genetic or morphological descent, focusing on physical traits or genetic sequences as the primary units of inheritance. However, this approach often overlooks the critical role of perception and attention in determining which traits are noticed, valued, and perpetuated within a population. Attentional cladistics posits that traits—whether biological (e.g., neotenous facial features), cultural (e.g., religious symbols), or technological (e.g., intuitive user interfaces)—persist by capturing and sustaining attention within intersubjective perception fields. These fields, which we term *perceptual selection fields*, are dynamic, emergent structures shaped by the collective attention of individuals or groups, influencing evolutionary outcomes through recursive feedback loops (Gibson, 1979; Tomasello, 2019). For example, a cultural artifact like a monument may persist not because of its material durability but because it consistently draws attention and elicits care, reinforcing its place in the evolutionary lineage.

Genetic models of evolution, grounded in Darwinian natural selection, focus on differential survival and reproduction of genetic replicators (Jacob, 1977). While these models are robust for explaining biological evolution, they are limited to genetic substrates and struggle to account for the rapid, non-genetic transmission of cultural or technological traits. Memetic models, which treat cultural units (memes) as replicators analogous to genes, attempt to bridge this gap by describing cultural transmission (Deacon, 1997). However, memetic models often fail to capture the dynamic, recursive nature of attention-driven selection. For instance, memes do not inherently explain why certain cultural artifacts, such as religious icons or viral internet phenomena, achieve disproportionate persistence compared to others. This is because memetic models lack a mechanism for modeling the affective and perceptual salience that drives selection. Attentional cladistics addresses this limitation by foregrounding attention as a primary evolutionary force, applicable across biological, cultural, and technological domains (Grice, 1957; Doctor et al., 2022).

To fully capture the interplay of attention, care, and meaning in evolutionary processes, a recursive, field-based approach is essential. Traditional models, whether genetic or memetic, treat evolution as a linear process of replication and variation, but they often neglect the feedback loops that amplify or suppress traits based on their perceptual impact. The RSVP framework, introduced in this paper, represents attention, care, and meaning as coupled scalar and vector fields, modulated by entropy, within a pseudo-Riemannian manifold. This field-theoretic approach draws on ecological theories of perception, which emphasize the role of environmental affordances in shaping behavior, and dynamical systems theory, which models recursive interactions (Gibson, 1979; Varela et al., 1991). By integrating these perspectives, RSVP provides a unified lens for understanding how attention shapes evolutionary trajectories across diverse domains, from biological traits to cultural artifacts (Doctor et al., 2022).

2 Attention as an Evolutionary Vector

Natural selection operates through differential survival and reproduction, where traits that confer fitness advantages are perpetuated. Attentional cladistics introduces *perceptual selection* as a complementary mechanism, where traits are prioritized based on their ability to attract and sustain attention within a population. For example, in biological systems, bright plumage in birds or expressive facial features in primates are selected not only for direct survival benefits but also for their capacity to capture attention, influencing mate choice or social interactions (Tinbergen, 1951). Similarly, in cultural systems, artifacts like catchy songs or iconic logos persist because they command attention, shaping collective behavior. Perceptual selection reframes evolution as a process driven by intersubjective attention dynamics, where the salience of a trait determines its evolutionary success (Doctor et al., 2022).

Attention is an energetic process, requiring cognitive and behavioral resources to be allocated toward specific signals in the environment. We define *care* as the directed allocation of these resources, modeled as a vector field that flows toward salient stimuli. The energetics of attention involve trade-offs: organisms or systems must prioritize certain signals over others, shaping evolutionary outcomes. For instance, in human societies, cultural artifacts like art, rituals, or social norms persist because they recruit collective care, reinforcing their salience over time (Grice, 1957; Hutchins, 1995). This process is analogous to a thermodynamic system, where attention flows toward regions of high salience, modulated by entropy. The allocation of care can be quantified as an energetic cost, where the persistence of a trait depends on its ability to minimize entropic decay while maximizing attentional focus (Friston, 2010; Doctor et al., 2022). This perspective aligns with the concept of care as a driver of intelligence, where goal-directedness and attention scale with cognitive complexity (Doctor et al., 2022).

Several examples illustrate the role of attentional selection. Neotenous traits, such as large eyes and small noses, elicit caregiving responses across species, as seen in the "baby schema" described by Lorenz (Lorenz, 1971). These traits persist because they attract attention and trigger nurturing behaviors, creating a feedback loop that reinforces their presence in a population. Language evolution is another case, where attention to phonetic patterns drives the standardization of sounds through recursive social reinforcement (Deacon, 1997). For example, the clarity and distinctiveness of certain phonemes make them more salient, increasing their adoption in linguistic systems. Facial expressivity in humans enhances social cooperation by attracting attention and conveying emotional states, a trait amplified through evolutionary feedback loops (Cieri et al., 2014). These examples demonstrate how attention acts as a vector, directing evolutionary change across biological and cultural domains, with care as a central driver (Doctor et al., 2022).

3 The RSVP Framework

The Relativistic Scalar Vector Plenum (RSVP) is a field-theoretic framework that models evolutionary dynamics through three interacting fields: a scalar field Φ representing salience or meaning potential, a vector field $\vec{\sqsubseteq}$ representing directed attention or care, and an entropy field S representing uncertainty or structural looseness. These fields evolve over a pseudo-Riemannian manifold (e.g., spacetime), capturing the recursive interactions that drive attentional cladistics. The RSVP framework draws inspiration from ecological perception, which views organisms as embedded in dynamic environments (Gibson, 1979), and dynamical systems theory, which models stability and change through attractors (Holling, 1973). By representing attention, care, and uncertainty as fields, RSVP provides a mathematical scaffold for unifying biological and cultural evolution, with care as a central invariant across domains (Doctor et al., 2022).

In the RSVP framework, care ($\vec{\sqsubseteq}$) directs attention toward salient traits (Φ), increasing their likelihood of persistence. Salience represents the perceptual or affective significance of a trait, such as the emotional impact of a cultural artifact or the visual prominence of a biological feature. Entropy (S) modulates the uncertainty that can destabilize meaning, such as cultural drift or environmental noise. For example, a cultural artifact like a monument maintains high salience through collective care, but entropy (e.g., fading cultural relevance) may erode its significance unless actively counteracted (Heylighen, 2016). The interplay of these fields is formalized through coupled partial differential equations (PDEs), which describe how salience, care, and entropy evolve over time and space (see Mathematical Appendix). This approach aligns with the concept of care as a driver of intelligence, where goal-directed behaviors scale with the complexity of an agent's cognitive light cone (Doctor et al., 2022).

The recursive nature of RSVP allows for the formation of attractors—stable configurations of salience and care that persist across generations. These attractors represent evolutionary lineages, such as neotenous traits in biology or enduring symbols in culture, stabilized by recursive feedback loops. For instance, a ritual that consistently draws collective attention becomes an attractor, maintaining its salience through repeated care (Hutchins, 1995). The dynamics of attractor evolution are governed by the interplay of Φ, $\vec{\sqsubseteq}$, and $\mathcal{S}$, which can lead to cladogenesis (the splitting of lineages) or the stabilization of traits (Friston, 2010). This framework provides a mathematical basis for understanding how attention drives evolutionary change, offering predictions for trait persistence and diversification (Doctor et al., 2022).

4 Attentional Lineages

Traits persist in attentional cladistics by recruiting care within intersubjective perception fields. Care is a vectorial process, directing cognitive, emotional, or behavioral resources toward traits that resonate affectively or cognitively. For example, religious icons persist because they elicit ritualized care, such as maintenance or veneration, which reinforces their salience across generations (Hutchins, 1995). This process is recursive: salient traits attract care, which enhances their salience, creating a self-reinforcing loop. The persistence of traits depends on their ability to maintain this loop against entropic forces, such as cultural forgetting or environmental degradation. This dynamic is evident in both biological systems (e.g., traits that elicit caregiving) and cultural systems (e.g., artifacts that evoke emotional resonance) (Lorenz, 1971; Doctor et al., 2022).

The baby schema, characterized by features like large eyes, small noses, and rounded faces, exemplifies a biological trait that recruits care. Lorenz (Lorenz, 1971) described how these features trigger caregiving responses across species, amplifying their persistence through attentional selection. For example, infants with pronounced neotenous features receive more attention and care, increasing their survival and reproductive success, which reinforces these traits in subsequent generations. Recent studies on human facial growth patterns compared to Neanderthals support this, showing how midfacial reduction enhances neotenous appearance, potentially driven by attentional selection (Schuh et al., 2025; Max Planck Society, 2025).

Cultural forms, such as myths, architectural styles, or legal codes, act as recursive salience vessels, maintaining their significance through collective attention and care. For example, epic narratives like the Iliad persist because they evoke emotional resonance and social coordination, reinforced through storytelling and cultural rituals (Deacon, 1997). These forms are analogous to genetic replicators but operate through attentional rather than material inheritance. The persistence of a cultural form depends on its ability to recruit care, such as through institutional support or communal engagement, which counteracts entropic drift (e.g., loss of relevance). This process mirrors biological lineages, where traits are stabilized through recursive selection (Heylighen, 2016; Doctor et al., 2022).

5 Self-Domestication and Neoteny

The domestication of wolves into dogs illustrates self-domestication driven by attentional selection. Wolves exhibiting traits like docility, playfulness, or neotenous features (e.g., floppy ears, juvenile faces) were favored by human attention, leading to a feedback loop where caregiving behaviors reinforced these traits (Belyaev, 2009). Belyaev's experiments with foxes demonstrated that selection for tameness produces a suite of neotenous traits, known as the domestication syndrome, including reduced aggression and altered craniofacial morphology (Wilkins et al., 2014). This process highlights how attention, rather than just survival pressures, shapes evolutionary outcomes, as humans preferentially cared for wolves with traits that elicited positive affective responses.

Human evolution reflects similar dynamics, where traits like reduced aggression, increased social tolerance, and neotenous features were selected through social attention. Cieri et al. (Cieri et al., 2014) argue that craniofacial feminization in humans, characterized by smaller jaws and more delicate features, correlates with increased social tolerance, a hallmark of self-domestication. This process is driven by recursive care fields, where social interactions amplify traits that elicit cooperation and caregiving. For example, individuals with expressive faces or less threatening appearances may have received more social support, enhancing their reproductive success and stabilizing these traits (Wrangham, 2019; Gleeson, 2019; Doctor et al., 2022). The concept of care as a driver of intelligence further supports this, suggesting that social attention scales with cognitive and cooperative capacities (Doctor et al., 2022).

A hypothesized mutation suppressing jaw growth in adolescence may have enhanced neotenous features in humans, increasing social cooperation by attracting care. Recent studies suggest that human midfacial growth differs significantly from Neanderthals, with reduced jaw prominence contributing to a more juvenile appearance (Schuh et al., 2025; Anthropology.net, 2025). This mutation may have been selected through attentional feedback loops, where individuals with neotenous features received more social care, enhancing their social integration and reproductive success. This hypothesis aligns with the broader framework of attentional cladistics, where perceptual selection drives evolutionary change through care-driven processes (Doctor et al., 2022).

6 Herms, Stones, and Stigmergy

Environmental modifications, such as cairns, trails, or monuments, serve as attentional markers that guide behavior and reinforce salience through stigmergic processes. Stigmergy refers to the coordination of actions through environmental traces, where modifications left by one agent influence the behavior of others (Heylighen, 2016). For example, a cairn on a mountain trail directs attention to a safe path, encouraging others to follow and add stones, reinforcing its salience over time. These markers encode information in the environment, shaping evolutionary trajectories by directing collective attention (Doctor et al., 2022).

Deer trails and boundary heaps (e.g., stone cairns) encode path memory, directing attention and behavior across generations. These structures are stigmergic, as they emerge from repeated interactions and persist through collective reinforcement (Wheeler, 1928). For instance, a boundary heap signals territorial limits, maintaining social order by attracting attention and care from community members. Over time, these markers become part of the environment's perceptual landscape, guiding behavior and stabilizing social or ecological patterns (Turner, 2000; Doctor et al., 2022).

Niche construction, such as beaver dams or termite mounds, amplifies salience inheritance by modifying environments to sustain attention-driven feedback loops (Laland et al., 2000). These structures act as extended phenotypes, channeling attention toward features that enhance survival or cooperation. For example, a beaver dam creates a stable water source, attracting attention from both beavers and other species, which reinforces its maintenance and ecological impact (Turner, 2000). This process illustrates how stigmergic modifications create self-reinforcing cycles of attention and care, driving evolutionary change (Doctor et al., 2022).

7 Mathematical Formulation

The RSVP framework formalizes attentional cladistics through coupled PDEs that describe the interactions of salience (Φ), care ($\vec{\sqsubseteq}$), and entropy ($\mathcal{S}$) fields. These equations, detailed in the Mathematical Appendix, model how attention drives trait persistence and cladogenesis. The framework draws on reaction-diffusion models and field theories to capture recursive dynamics, providing a mathematical basis for understanding attentional selection (Turing, 1952; Friston, 2010; Doctor et al., 2022).

Attractors—stable configurations of salience and care—drift through recursive feedback loops, shaping evolutionary trajectories. For example, a cultural artifact like a monument may act as an attractor, drawing attention and care that stabilize its salience over time (Holling, 1973). The Mathematical Appendix provides equations for modeling this drift, capturing how recursive care influences trait persistence and diversification (Doctor et al., 2022).

Simulations of RSVP dynamics can predict thresholds for self-domestication and cultural stabilization. By varying parameters like attentional focusing (α) or entropy sensitivity (β), researchers can explore how runaway care dynamics lead to phenomena like neoteny or cultural persistence (Hinton and Nowlan, 1987). These simulations offer testable hypotheses for evolutionary processes, such as the emergence of stable cultural attractors or the amplification of neotenous traits

8 Attentional Cladistics and Conscious Evolution

Meaning emerges as a stabilized scalar field (Φ) within the RSVP framework, shaped by recursive attention and care. This view aligns with pragmatic theories of meaning, where significance arises from inferred attention and intention (Grice, 1957). For example, a cultural symbol like a flag gains meaning through repeated attentional reinforcement within a community, stabilized by collective care and ritual. The RSVP framework models this as a dynamic interplay of Φ, $\vec{\sqsubseteq}$, and $\mathcal{S}$, where meaning persists through recursive stabilization (Doctor et al., 2022).

Consciousness is modeled as the recursive stabilization of salience attractors, integrating sensory and cognitive processes across time. This perspective resonates with enactivist theories, which view cognition as a dynamic, embodied process (Varela et al., 1991). In RSVP, consciousness emerges from the interplay of Φ, $\vec{\sqsubseteq}$, and $\mathcal{S}$, where stable attractors represent coherent cognitive structures, such as memories or concepts. This model provides a field-theoretic account of how consciousness arises from attentional dynamics, bridging cognitive science and evolutionary theory. The concept of a cognitive light cone, which defines the scope of an agent's care and goal-directedness, further supports this, linking consciousness to the scale of attentional processes (Doctor et al., 2022).

Attentional cladistics has profound implications for cultural evolution, AI design, and planetary cognition. In culture, it explains the persistence of salient artifacts, such as art, literature, or institutions, which are stabilized through collective attention (Deacon, 1997). In AI, attention mechanisms in neural networks, such as those in transformer models, mirror RSVP dynamics, suggesting applications in designing systems that prioritize salient features (Friston, 2010). At a planetary scale, attentional cladistics could model the emergence of collective cognitive systems, where global attention flows shape ecological and cultural outcomes, such as climate action or global communication networks (Hutchins, 1995; Doctor et al., 2022). The Bodhisattva's vow, emphasizing care for all sentient beings, offers a design principle for advancing intelligence in both natural and synthetic systems

9 Conclusion and Future Directions

Attentional cladistics unifies biological and cultural evolution by emphasizing attention as a primary evolutionary driver. By focusing on perceptual selection, it bridges gaps between genetic, memetic, and ecological models, offering a comprehensive framework for understanding trait persistence across domains (Tinbergen, 1951; Laland et al., 2000). This approach highlights the role of attention in shaping evolutionary lineages, from neotenous traits in biology to enduring symbols in culture.

The RSVP framework provides a mathematical and conceptual scaffold for integrating diverse evolutionary phenomena. Its field-theoretic approach captures the recursive dynamics of attention, care, and entropy, offering a unified lens for studying self-domestication, cultural transmission, and cognitive evolution (Friston, 2010; Varela et al., 1991; Doctor et al., 2022). By modeling evolutionary processes as coupled fields, RSVP enables predictions about trait persistence and cladogenesis, applicable to both biological and cultural systems.

Future research should focus on empirical tests of RSVP predictions, such as simulations of attentional attractors or experimental studies of care-driven trait selection. Key questions include: How do attentional thresholds influence self-domestication? Can RSVP predict the emergence of cultural attractors? Experimental paradigms, such as longitudinal studies of caregiving behaviors or computational models of stigmergic systems, will be critical

10 Mathematical Appendix: RSVP Field Dynamics for Attentional Cladistics

10.1 Overview

We define a **Relativistic Scalar Vector Plenum (RSVP)** as a triplet of interacting fields over a spacetime manifold M, capturing the recursive coupling between:

- **Salience** (scalar field Φ),
- **Care/attention** (vector field $\vec{\sqsubseteq}$),
- **Uncertainty/entropy** (entropy field $\mathcal{S}$).

We model **attentional cladistics** as the evolutionary dynamics of patterns that persist through recursive reinforcement within this field triplet. Let:

$$\text{RSVP} := \left(\Phi : M \to \mathbb{R}, \quad \vec{\sqsubseteq} \in \Gamma(TM), \quad \mathcal{S} : M \to \mathbb{R}_{\geq 0}\right)$$

where M is a pseudo-Riemannian manifold (e.g., spacetime), $\Gamma(TM)$ the space of vector fields, and the fields evolve by coupled PDEs with feedback terms (Turing, 1952; Doctor et al., 2022).

10.2 Field Dynamics

The RSVP system obeys the following PDEs, where each field modulates the others:

10.2.1 Scalar Salience Field: Φ

The scalar field represents perceptual salience or meaning potential:

$$\Box\Phi + \alpha(\nabla \cdot \vec{\sqsubseteq}) - \beta\frac{\delta\mathcal{S}}{\delta\Phi} = 0$$

- $\Box = \nabla^\mu\nabla_\mu$: d'Alembertian operator,
- α: strength of attentional focusing,
- β: entropy sensitivity,
- *Interpretation*: Φ increases where attention accumulates (divergence of $\vec{\sqsubseteq}$) and decreases where entropy resists stabilization (Friston, 2010).

10.2.2 Vector Care Field: $\vec{\sqsubseteq}$

The vector field represents the directed flow of care/attention:

$$\nabla_\mu\mathcal{T}^{\mu\nu} = \lambda\Phi\nabla^\nu\Phi - \kappa\nabla^\nu\mathcal{S}$$

- $\mathcal{T}^{\mu\nu} = \mathcal{S} \cdot \vec{\sqsubseteq}^\mu\vec{\sqsubseteq}^\nu$: stress-energy-like tensor for attentional flow,
- λ: salience-affinity coefficient,
- κ: entropic resistance,
- *Interpretation*: attention flows along salience gradients, but dissipates along entropy gradients (Holling, 1973).

10.2.3 Entropy Field: $\mathcal{S}$

The entropy field tracks uncertainty or structural looseness:

$$\partial_t \mathcal{S} + \vec{\sqsubseteq} \cdot \nabla \mathcal{S} = \gamma \|\nabla \Phi\|^2 - \delta \mathcal{S}$$

- γ: informational gain from perceptual differentiation,
- δ: entropy decay (compression),
- *Interpretation*: entropy rises with steep salience gradients (potential ambiguity), and decays when resolved through care (Friston, 2010).

10.3 Recursive Coupling & Cladistic Inheritance

Define a **recursively stabilized trait** $\tau \subset M$ as a region where:

$$\frac{d}{dt}\left(\int_\tau \Phi \cdot \mathcal{S}^{-1} \cdot |\vec{\sqsubseteq}|\, dV\right) > 0$$

- High salience, focused care, and low entropy reinforce trait persistence.
- This corresponds to *attentionally inherited features* (e.g., baby schema, cairns, icons) (Lorenz, 1971; Heylighen, 2016).

A **trait lineage** is defined by:

$$\mathcal{L}(\tau) = \{\tau_i \subset M \mid \tau_{i+1} \approx \mathrm{argmax}_\tau\, (\Phi(\tau) \cdot \mathcal{A}(\tau_i, \tau))\}$$

where $\mathcal{A}(\tau_i, \tau_j)$ is an **attentional affinity kernel** encoding recursive recognition, similarity, or affective bias (e.g., via radial basis or perceptual similarity metrics)

10.4 Stigmergic Construction as Spacetime Marking

Let an **environmental mark** be a local modification to Φ via:

$$\Phi(x) \leftarrow \Phi(x) + \sum_i \delta(x - x_i) \cdot w_i$$

where each w_i is a unit of attention-carrying action (e.g., a stone placed on a cairn, a bee depositing wax)

These accrete into **attention attractors**:

$$\boldsymbol{\nabla} \cdot \vec{\sqsubseteq}(x) \propto \Phi(x)$$

Thus creating **stigmergic self-focusing fields**: a trace draws more attention, which raises salience, which draws more care

10.5 Attractor Evolution and Meaning Stabilization

Let $\mathcal{A}_t \subset M$ be the set of field attractors at time t, defined as local minima of entropy and maxima of salience and care:

$$\mathcal{A}_t := \left\{x \in M \,\middle|\, \nabla\Phi(x) = 0,\ \boldsymbol{\nabla} \cdot \vec{\sqsubseteq}(x) > 0,\ \mathcal{S}(x) \text{ minimal}\right\}$$

The **evolution of consciousness** corresponds to the stabilization and migration of these attractors:

$$\frac{d\mathcal{A}_t}{dt} = \mathrm{Drift}(\nabla\Phi, \vec{\sqsubseteq}, \mathcal{S})$$

This equation captures **attentional cladogenesis**—the splitting, merging, or stabilization of meaningful structures in cognitive or cultural space

10.6 Phase Portraits and Simulation Suggestions

- Simulate 2D scalar field $\Phi(x, y, t)$ with sources of stigmergic marking.
- Let agent flows $\vec{\sqsubseteq}$ respond to Φ, modulated by entropy.
- Track formation and persistence of attractors.
- Vary parameters α, β, γ to explore self-domestication thresholds and runaway care dynamics (Hinton and Nowlan, 1987).

10.7 Toward a Category-Theoretic Reformulation

The RSVP field configuration space is defined as an object in a derived category $\mathcal{D}(\mathbf{RSVP})$, where morphisms are field-to-field transitions preserving attractor structure. This framework explores functors such as $F : \mathbf{Culture} \to \mathbf{RSVP}_\infty$, mapping recursive symbolic forms to stabilized attractors, and $G : \mathbf{BioLineage} \to \mathbf{RSVP}_\infty$, mapping care-inherited traits to salience flows. This approach opens a path toward **Derived Evolutionary Field Theory**, integrating attention, care, entropy, and ecological memory under a unifying functorial semantics (Deacon, 1997; Maturana and Varela, 1980; Doctor et al., 2022).

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