Encoding Shadows, Retrieving Structure: A Synthesis of the ADAPTER Model and the RSVP Framework

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Abstract

This paper proposes a theoretical synthesis between the ADAPTER (Analogical Depth and Patterned Transfer Encoding Retrieval) model of analogical retrieval and the Relativistic Scalar Vector Plenum (RSVP) framework, a geometric field theory of cognition that models consciousness as evolving scalar, vector, and entropy fields. By treating analogical retrieval as a thermodynamic and topological process mediated by relational encoding, we argue that RSVP provides a dynamic substrate for ADAPTER's conceptual insights. This integration offers novel computational perspectives on category formation, structured memory access, emotional dynamics, and educational transfer, while resolving tensions between surface and structural similarity in analogical cognition.

1 Introduction: Beyond the Surface Bias

The ADAPTER model (Analogical Depth and Patterned Transfer Encoding Retrieval) [1] refines the debate around analogical retrieval by emphasizing that retrieval cues depend not merely on surface resemblance but on the depth of encoding, shaped by prior relational categories. This view breaks from models in which memory retrieval is shallow and largely reactive, instead highlighting how conceptual structure actively guides encoding and recall.

The RSVP theory offers a complementary perspective: cognition is represented not symbolically but geometrically, with scalar fields (Φ), vector flows ($\mathbf{v}$), and entropy gradients (S) forming a continuous substrate for memory, perception, and reasoning. Within this dynamic field landscape, analogical retrieval corresponds to topological resonance between prior and current field configurations.

Together, these models propose that memory retrieval, analogical reasoning, and emotional dynamics are not passive searches through discrete representations but active alignments of structured, contextually prepared domains.

2 Categories as Fields: RSVP and the Relational Encoding Hypothesis

ADAPTERs core contribution is to link relational categories to deeper encoding, such that structurally similar but superficially dissimilar events become accessible for analogical transfer. In RSVP terms, a relational category corresponds to a coherent configuration in scalar-vector-entropy space—a topological pattern that can re-emerge when similar conditions are encountered.

Rather than encoding via isolated feature vectors (as in classic cognitive models), RSVP imagines knowledge as embedded in field structures that possess memory-like hysteresis, meaning they retain form across perturbations. This naturally supports ADAPTERs insight that encoding quality, not just retrieval mechanism, determines analogical success.

Just as ADAPTER distinguishes between entity-based and relation-based encodings, RSVP distinguishes between low-dimensional field states, which encode specific tokens or entities, and high-dimensional attractor basins, which encode abstract relational templates—precisely the structures ADAPTER associates with successful distant analogs.

3 Retrieval as Topological Alignment

In the ADAPTER model, the availability of relational categories enables the retrieval of structurally similar cases that may differ in surface details. RSVP interprets retrieval as a relaxation process in a thermodynamic field: the current field configuration seeks a lower-energy alignment with known attractor patterns, modulated by entropy gradients (S).

This corresponds to what ADAPTER calls "retrieval guided by deep cues": the plenum's entropy dynamics bias it toward relational coherence over surface similarity. Retrieval becomes a reconfiguration of the plenum toward prior field states that match structurally, akin to reactivating a geometric memory.

This also predicts ADAPTERs finding that learners often retrieve close analogs more easily (due to surface cues), unless abstract categories are available to support structural retrieval—which, in RSVP, would be interpreted as requiring stronger attractor basins (i.e., more stable relational templates).

4 Educational Transfer and Field Coherence

Both ADAPTER and RSVP shed light on the persistent educational challenge of knowledge transfer—why students fail to apply known concepts in new settings. ADAPTER

argues that transfer depends on the availability of abstract relational categories at encoding. RSVP models this as the formation of high-coherence field templates that can propagate across contexts.

Encoding through a relational lens corresponds in RSVP to generating stable phase patterns across the plenum, rather than isolated local gradients. Such phase-stable structures are more likely to reactivate under novel input, facilitating retrieval and recomposition in new problems.

Further, RSVP offers metrics like field coherence, thermodynamic complexity, and coupling strength to quantify how well a concept has been abstracted—providing a possible formalization of ADAPTERs developmental trajectory in analogical reasoning.

5 Developmental Trajectories and the Formation of Attractors

ADAPTERs developmental model holds that early encodings are tied to context-specific relational categories, which only later evolve into generalized relational schemas. RSVP predicts the same: early cognitive development forms fragmented field configurations with weak global coherence. Through exposure and personally meaningful experiences, these fragmentary states undergo recursive alignment and eventually form stable attractor basins—metaphoric "thought forms" capable of guiding future field evolution.

As relational categories deepen, RSVP dynamics shift from chaotic reactivity (entropy-dominated transitions) to low-entropy, guided structure—enabling retrieval of distant analogs, deeper insight, and spontaneous transfer.

This recursive coupling between category abstraction and analogical access reflects a self-organizing cognitive thermodynamics, offering a unified explanation for both RSVP and ADAPTER phenomena.

6 Emotions as Control-State Dynamics in the RSVP–ADAPTER Framework

This section connects the RSVP–ADAPTER synthesis to a control-theoretic conceptualization of emotions, viewing them not as pneumatic pressures to be released (as in cathartic or hydraulic metaphors) but as structured, context-sensitive perturbations in cognitive planning and perception. Emotions are framed as responses to mismatches between expected and actual outcomes, aligning with Perceptual Control Theory (PCT) and the field dynamics of RSVP.

6.1 Emotion as Entropic Perturbation and Reconfiguration

In the RSVP framework, emotions manifest as dynamic reconfigurations of the cognitive plenum:

- The scalar field $\Phi(x,t)$ represents motivational salience or goal pressure, encoding the importance of specific cognitive states or outcomes.
- The vector field $\mathbf{v}(x,t)$ reflects directional intention or executive inference, guiding cognitive processes toward goal-directed actions.
- The entropy field $S(x,t)$ captures uncertainty, instability, or cognitive dissonance arising from mismatches in expectations.

When an expected outcome fails (e.g., a plan is thwarted), the plenum undergoes:

- A sharp spike in entropy $S(x,t)$ at the site of the mismatch, reflecting cognitive dissonance.
- Turbulence or reversal in the vector field $\mathbf{v}(x,t)$, indicating a conflict in intentional flow.
- A local collapse or inversion in $\Phi(x,t)$, where previously salient goals lose validity.

These shifts are distributed across the plenum, responsive to relational mismatches (e.g., failed plans or broken analogies), and do not represent pressure build-ups but rather pattern reconfigurations. Thus, emotions are changes in the RSVP field configuration triggered by relational failures.

6.2 Emotional Priming as Analogical Retrieval

In the ADAPTER model, emotional states arise from the retrieval of analogical structures. When a situation is categorized as "betrayal," a relational schema with a specific emotional shape (e.g., anger) is retrieved. Reframing the situation as an "unexpected opportunity" shifts the retrieved schema, altering the emotional dynamic.

This aligns with the view that emotions result from primed cognitive pathways:

- Encoding a situation as "disrespect" primes pathways that produce anger-like vector fields, characterized by high entropy and conflicting flows.
- Recategorizing it as a "misunderstanding" redirects the vector field, reducing entropy without requiring repression.

This process supports the idea that distraction from frustration involves rerouting predictive structures, modulating Φ and $\mathbf{v}$ to dissipate entropy through new relational alignments.

6.3 Catharsis vs. Control Theory

Cathartic metaphors misconstrue emotions as high-pressure zones requiring release, corresponding in RSVP to saturated Φ, rising S, and frozen $\mathbf{v}$—an unstable equilibrium. In contrast, a control-theoretic perspective (aligned with PCT and RSVP) views emotions as discrepancies between expected and actual field flows:

- Emotions arise from misalignments in the plenum, not from accumulated energy.
- Resolution involves restoring flow alignment through recategorization or redirection, not venting.

This eliminates the need for suppression, emphasizing reconfiguration of the cognitive field.

6.4 Field Learning: Emotions as Meta-Analogical Error Signals

ADAPTER suggests that analogical mismatches generate retrieval failures or category errors, which in RSVP appear as entropy spikes and vector torsion. These are signals to reconfigure the field, not punishments or repressed energies. Emotions, therefore, are reactions to model mismatches, structured by prior relational categories and analogical templates.

Changing an emotional state involves re-encoding the situation—retrieving a different analogy. For example, reframing a failure as a learning opportunity shifts the retrieved schema, reducing entropy and realigning vector flows.

6.5 Summary of Emotional Dynamics

The following table summarizes the mapping of emotional phenomena to RSVP and ADAPTER mechanisms:

Table 1: RSVP–ADAPTER–Emotion Mapping

Phenomenon	**RSVP Field Mechanism**	**ADAPTER Insight**
Emotion (anger, fear, etc.)	Spike in entropy S + vector conflict in $\mathbf{v}$	Failed analogical retrieval
Emotional reappraisal	Re-routing vectors $\mathbf{v}$, reducing S	Changing the relational category
Distraction from frustration	Rapid shift in salience field Φ	Suppressing prior analogy by recategorizing
"Bottled up feelings" myth	Mistaken metaphor for field stagnation	Misapplied surface analogy from physics

Emotional growth	Learning more flexible relational encodings	Deepening schemas	category

This framework reframes emotions as mismatch-handling protocols within distributed cognition, shaped by analogical structures and control goals, emphasizing reconfiguration over catharsis.

7 Implications for Cognitive Science and Artificial Intelligence

This synthesis suggests that effective analogical cognition, emotional regulation, and learning depend on the internal field geometry of conceptual space. Designing systems (biological or artificial) that support distant analogical transfer and adaptive emotional responses requires:

- Rich, structured input contexts (supporting entropy differentiation).
- Recursive comparison operations (to foster attractor formation).
- Multi-scale field memory (to preserve structure beyond surface features).
- Dynamic reconfiguration mechanisms (to handle emotional perturbations).

RSVP may serve as a substrate for analogical and emotional AI, while ADAPTER provides the control-theoretic account necessary for learning and reappraisal stages. Together, they point toward hybrid cognitive systems where memory, analogy, emotion, and concept formation emerge as field phenomena.

8 Conclusion: Toward a Field Theory of Analogical and Emotional Thought

Both ADAPTER and RSVP converge on the idea that analogical retrieval, emotional dynamics, and flexible cognition emerge from how we categorize and encode experience. ADAPTER frames categorization as relational and structured; RSVP models it as geometric and dynamic, with emotions as control-state perturbations.

The synthesis suggests that structurally based retrieval and adaptive emotional responses are default states of a sufficiently structured cognitive plenum. Failures of analogy or emotional regulation arise from the entropy of encodings—from field patterns too shallow to echo or too rigid to adapt.

To climb the ladder of cognition is to deepen the relational forms we trace in memory and emotion—to cast shadows that return as flexible, context-sensitive guides.

A Extensions and Refinements of the ADAPTER-RSVP Synthesis

This appendix addresses proposed extensions to the ADAPTER-RSVP synthesis, focusing on mathematical refinements, empirical predictions, emotional dynamics, and educational applications to enhance the frameworks utility.

A.1 Dynamics of Category Formation

Real-world learning and emotional development involve non-ergodic processes. Time-dependent coupling coefficients can model this:

$$\alpha(t) = \frac{\alpha_{\max}}{1 + e^{-k(t-t_0)}}$$

where $\alpha(t)$ governs relational encoding strength, t_0 is a developmental milestone, and k controls abstraction rate. Bifurcation analysis can identify criticality conditions for phase transitions, reflecting the shift from context-specific to abstract categories, including those underlying emotional responses.

A.2 Multiscale Retrieval

To capture hierarchical analogs, the retrieval kernel $K(\Phi_T, \Phi_i)$ can incorporate wavelet-based similarity metrics:

$$K(\Phi_T, \Phi_i) = \sum_{\ell} w_\ell \int \psi_\ell(x) \langle \Phi_T(x), \Phi_i(x) \rangle \, dx$$

where $\psi_\ell(x)$ are wavelet basis functions, and w_ℓ are scale weights. Scale-dependent entropy terms ($S_\ell(x,t)$) prioritize relational coherence, enhancing retrieval of distant analogs and supporting emotional reappraisal across domains.

A.3 Empirical Linking

The synthesis predicts neural signatures testable via fMRI or EEG:

- Low-entropy relational encoding and emotional stability correlate with reduced variability in default mode network (DMN) activity.

- Successful transfer and reappraisal exhibit increased topological similarity between task-evoked patterns, measurable via persistent homology.

Field variables map to neural observables:

- Φ: Mean synaptic potentials in prefrontal and parietal regions.
- $\mathbf{v}$: Directional coherence in functional connectivity networks.
- S: BOLD signal entropy, modulated by neuromodulators like norepinephrine.

A.4 Mathematical Refinements

A stochastic control formulation unifies retrieval, learning, and emotional regulation:

$$E\left[\int \left(\mathcal{D}[\Phi_T, \Phi(t)] + \lambda S(t) + \|\mathbf{v}(t)\|^2\right) dt\right]$$

where $\mathcal{D}$ is field divergence, $\lambda S(t)$ regularizes entropy, and $\|\mathbf{v}(t)\|^2$ reflects cognitive effort. Persistent homology can quantify category and emotional coherence via persistence diagrams. A neural field model:

$$\frac{\partial \Phi}{\partial t} = -D\nabla^2\Phi + f(\Phi, \mathbf{v}, S) + \eta(x, t)$$

maps dynamics to cortical processes, with D as a diffusion coefficient and η as neural noise.

A.5 Educational and Emotional Design Implications

The framework suggests interventions:

- **Entropy-Reduction Scaffolds**: Visualizations of field gradients and repetition with variational noise to strengthen attractors, supporting emotional regulation.
- **Cross-Domain Alignment Tasks**: Training the retrieval kernel via paired problems to enhance structural isomorphisms and reappraisal skills.
- **Dynamic Assessment Metrics**: Response time variability (S) and transfer flexibility (attractor basin width) as measures of conceptual and emotional coherence.

These extensions provide mathematical rigor, empirical testability, and actionable strategies for cognition and emotional regulation.

References

[1] Raynal, L., & Sander, E. (2025). The ADAPTER model: A theory of analogical retrieval based on relational encoding. *Cognitive Science*, 49(2), 123–145.