Hypotheses

> All hypotheses below are **exploratory**. None should be treated as established conclusions. Hypotheses are extracted and organized from existing material; no new hypotheses have been introduced.

H1. Structure Discoverer Hypothesis

Claim: Humans may possess a comparative advantage in structure discovery.

```
AI
├─ Computation
├─ Summarization
├─ Organization
└─ Visualization

Human
├─ Structure Discovery
├─ Question Generation
├─ Meaning Attribution
└─ Research Direction Selection
```

This represents a **difference in roles**, not a difference in overall capability.

Status: Exploratory. Currently no controlled evidence.

H2. Representation Transformation Hypothesis

Claim: Some difficult problems become tractable not by reducing computation, but by changing the problem's representation.

```
Problem
  ↓
Representation Transformation
  ↓
Visible Structure
  ↓
Human Recognition
  ↓
Insight
```

Original Form	Transformed Form
Boolean expression	Karnaugh map
Protein folding data	Foldit puzzle
Numerical data	Visualization
Complex information	Structural diagram

Status: Supported by multiple case observations; requires systematic validation.

H3. Attention Filter Hypothesis

Claim: Humans do not investigate every pattern. A prior selection process occurs.

```
Many Patterns
    ↓
Attention Filter
    ↓
Selected Structures
    ↓
Meaning
    ↓
Questions
```

Open question: What determines which patterns pass the attention filter?

Formal connection: The attention filter is the mechanism governing the selection function **A** in Definition 3.2 (SRT v0.3). The filter's criteria correspond to Definition 3.2, Condition 4 (criterion opacity): the filter operates implicitly, without the researcher making its criteria explicit.

Status: Exploratory. See OP-01.

H4. Significance Filter Hypothesis

Claim: Beyond attention, humans apply an implicit filter evaluating whether a structure is **worth investigating**.

```
Pattern
  ↓
Structure
  ↓
Significance Filter
  ↓
Question
```

Possible conditions for passing the filter:

- **Compression** — The structure compresses a large amount of information into a short rule
- **Prediction** — The structure enables prediction of unobserved cases
- **Generalization** — The structure appears applicable across multiple domains
- **Explanation pull** — The structure points toward a generative cause; the researcher anticipates finding one

Formal connection: The significance filter passes structure **C** if and only if **C** satisfies Definition 3.3 (Explanatory Significance, SRT v0.3). The four candidate criteria above correspond to operationalized measurement specifications in SRT v0.3, Section 5 (H4 table).

Operationalized criteria (SRT v0.3):

Criterion	Formal operationalization
Compression	comp(C) = 1 − (|description(G)| / |enumeration(C)|)
Prediction	Accuracy on held-out test set above domain baseline
Generalization	gen(C) = |{domains d : C instantiated in d}|

Criterion	Formal operationalization
Explanation pull	Pre-investigation confidence rating (1–10)

Status: Exploratory. Formal operationalization proposed in SRT v0.3; criteria not yet empirically validated. See OP-02.

H5. Explanation Anticipation Hypothesis

Claim: Humans anticipate the existence of an explanation before they discover it.

```
Visible Regularity
  ↓
Expectation of Explanation
  ↓
Search
  ↓
Explanation
```

People perceive that a pattern "does not seem random" **before** they have identified its cause. The sense of non-randomness may precede — and motivate — the search for structure.

Formal connection: Explanation anticipation corresponds to satisfying Conditions 1 and 2 of Definition 3.3 (SRT v0.3) **before** Condition 4 is reached — the non-randomness is perceived and the explanation is implied, but sustained investigation has not yet been committed.

Status: Exploratory. Empirical research design proposed: SRT v0.3, Section 10.2 (Pre-Discovery Confidence Rating Paradigm). See OP-03.

H6. Explanatory Significance Hypothesis

Claim: Research begins not from structure discovery per se, but from the detection of **explanatory potential** in a structure.

```
Visible Pattern
  ↓
Hidden Structure
  ↓
Perceived Explanatory Potential
  ↓
Research Question
```

Formal connection: H6 is the primary motivation for Definition 3.3 (Explanatory Significance, SRT v0.3). The claim is that the transition to research is governed specifically by a structure satisfying Conditions 1–3 of Definition 3.3 (Condition 4 being the research-threshold crossing itself) — not by structure recognition (Definition 3.1) alone.

Status: Exploratory. Empirical research design proposed: SRT v0.3, Section 10.3 (Research Worthiness Judgment Paradigm).

H7. Structure Discoverer Hypothesis — Mature Version

A revision of H1, incorporating developments from H3–H6.

```
Human
  ↓
Structure Discovery
  ↓
Significance Evaluation
  ↓
Question Generation
  ↓
Research
```

The core human advantage may not be pattern recognition per se, but the ability to **evaluate which structures carry explanatory significance**.

This reframes the human role from **structure discoverer** to **explanation opportunity detector**.

Formal connection: Under SRT v0.3, H7 can be stated precisely: the human comparative advantage is calibrated and reliable estimation of whether a structure **C** satisfies Definition 3.3 (Explanatory Significance) — across diverse domains, without explicit enumeration of the four conditions.

Connection to HARCT (Paper 5): In long-term Human-AI collaboration, the human retained research direction and goal selection. This is consistent with H7: the human's core contribution is evaluating which structures satisfy Definition 3.3 and sustaining investigation toward them.

Status: Exploratory (revision of H1). Empirical research design proposed: SRT v0.3, Section 10.1 (Competitive Discovery Paradigm). See OP-06.

H8. Concept-as-Lens Hypothesis (Integrated Extension)

From SRT v0.3 — elevated from candidate hypothesis to integrated extension hypothesis.

Claim: Concepts function as observation lenses: a change in concept may produce a change in what can be **recognized as a structure** (Definition 3.1, Condition 1: holistic recognition).

```
Existing Concept
      ↓
Enables holistic recognition of certain structures [Definition 3.1]
      ↓
New Concept acquired
      ↓
Enables holistic recognition of previously unrecognizable structures
```

Examples:

- Without "Hamming Weight Layer": ring/corner/point patterns are visible as **patterns** but not recognized as **structures** (Condition 3 of Definition 3.1 is not yet perceived)
- With "structural invariance": the question "what is preserved under rearrangement?" becomes structurally formulable

Formal connection: Definition 3.1, Condition 1 (holistic recognition) depends on the observer's conceptual repertoire. H8 states that this dependence is systematic and directional: acquiring a concept expands the set of configurations satisfying Condition 1 for that observer.

Status: Integrated extension hypothesis (elevated from candidate in SRT v0.3). Not yet empirically tested. See OP-07.

H9. Concept Evolution Hypothesis (Integrated Extension)

From SRT v0.3 — elevated from candidate hypothesis to integrated extension hypothesis.

Claim: Research generates concepts, and concepts (via H8) generate further research through expanded perception.

```
Research
  ↓ (output)
Concept
  ↓ (H8: expanded recognition)
New structures become visible [Definition 3.1, Condition 1 now satisfied]
  ↓ (Definition 3.3: significance detection)
New Research Questions
  ↓
New Research
```

Formal connection: H9 describes how Definition 3.1, Condition 1 (holistic recognition) is a variable over time — it expands as the researcher's conceptual repertoire grows through H8. Each completed research cycle potentially adds a concept that enables new structures to be recognized, which enables new instances of Definition 3.3 (explanatory significance detection), which enables new research.

Evidence: The Concept Genealogy (condensed chain in inha20/SESSION_START.md, section "Concept Genealogy"; the full 7-step text was Research-Portfolio/ConceptGenealogy.md, deleted 2026-06-20 and available only from the Research-Portfolio git history, 15f97ad^) documents H9 in operation over this research program's history.

Status: Integrated extension hypothesis (elevated from candidate in SRT v0.3). Consistent with program history. Formal test not yet designed.

H10. Generative Concept Hypothesis (Integrated Extension)

From SRT v0.3 — elevated from candidate hypothesis to integrated extension hypothesis.

Claim: Concepts differ in their generativity — some expand perception more broadly and durably than others (via H8 and H9).

Candidate operationalization:

Criterion	Measurement
Perception expansion	Count structures satisfying Definition 3.1 Condition 1 before and after concept acquisition
Research yield	Count research questions traceable to the concept via H9 cycle
Transferability	Count independent domains in which the concept applies
Durability	Years of continued productive use
Depth	Expert judgment on structural depth of phenomena revealed

Examples in this program:

- "Structural invariance": high generativity — directly generated Paper 3, contributed to SRT framework, connects to Papers 1–2 in retrospect
- "Hamming Weight Layer": medium generativity — essential for Paper 2, more domain-specific
- "Concept-as-Lens" (H8): potentially very high generativity — if valid, applies across all scientific domains

Status: Integrated extension hypothesis (elevated from candidate in SRT v0.3). Operationalization proposed; not yet validated. See OP-07, Q14.