

The Law of Existence: Derived Meta-Principle and Ontology Predicates

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Abstract

Recognition Science (RS) treats *cost* as primitive and uses it to define ontology before any physics is introduced. This paper isolates a single meta-structure: a uniquely forced cost functional J on positive ratios, its interpretation as a *defect* (existence cost), the resulting *Law of Existence* (a unique defect-zero element), and a derived meta-principle: $\lim_{x \rightarrow 0^+} J(x) = \infty$, i.e. “nothing cannot exist” because “nothing” carries infinite cost. On top of this cost foundation we define RS-native predicates for *exists*, *true*, and *real*: existence is defect-zero, truth is stability under recognition iteration, and reality is existence plus membership in a discrete RS skeleton (here represented by a φ -generated ladder).

1. Scope

This paper is deliberately pre-physical. It does not introduce spacetime, energy, or any empirical calibration. The goal is only to state, in RS terms, what it means for something to *exist*, for a statement to be *true*, and for something to be *real*.

2. Cost-first foundation and the forced form of J

RS begins with a cost functional J over positive ratios. The key move in this paper is that the meta-principle (MP) is *not* assumed as a primitive slogan; it is recovered as a theorem about the boundary behavior of J .

2.1 Axioms on J (log-coordinates)

Let $J : \mathbb{R}_{>0} \rightarrow \mathbb{R}$ be a cost functional. Assume:

Definition 1 (Cost axioms). Define $j : \mathbb{R} \rightarrow \mathbb{R}$ by $j(t) := J(e^t)$. We assume:

1. (Normalization) $J(1) = 0$.
2. (Recognition composition law) For all $x, y > 0$,

$$J(xy) + J(x/y) = 2J(x)J(y) + 2J(x) + 2J(y).$$

3. (Calibration) j is twice differentiable at 0 and $j''(0) = 1$.

2.2 Deriving the canonical J

Theorem 1 (Canonical form of J). Under the cost axioms above (and sufficient differentiability to justify the steps below),

$$J(x) = \frac{1}{2} \left(x + \frac{1}{x} \right) - 1 \quad (x > 0).$$

Proof. Define $F : \mathbb{R} \rightarrow \mathbb{R}$ by $F(t) := 1 + J(e^t) = 1 + j(t)$. Substitute $x = e^t$ and $y = e^s$ into the composition law and rewrite in terms of F :

$$F(t+s) + F(t-s) = 2F(t)F(s).$$

Normalization gives $F(0) = 1$. Setting $t = 0$ yields $F(s) + F(-s) = 2F(0)F(s) = 2F(s)$, hence F is even and $F'(0) = 0$. Differentiate the functional equation twice with respect to s and then set $s = 0$:

$$F''(t) + F''(t) = 2F(t)F''(0) \Rightarrow F''(t) = F''(0)F(t).$$

Since $F(t) = 1 + j(t)$, calibration $j''(0) = 1$ gives $F''(0) = 1$, hence $F''(t) = F(t)$. With $F(0) = 1$ and $F'(0) = 0$, the unique solution is $F(t) = \cosh(t)$. Therefore $J(e^t) = F(t) - 1 = \cosh(t) - 1 = \frac{1}{2}(e^t + e^{-t}) - 1$, i.e.

$$J(x) = \frac{1}{2} \left(x + \frac{1}{x} \right) - 1.$$

□

3. Defect and the Law of Existence

RS uses the cost functional itself as an *existence defect*.

Definition 2 (Defect). *Define the defect function $\text{defect} : \mathbb{R}_{>0} \rightarrow \mathbb{R}_{\geq 0}$ by*

$$\text{defect}(x) := J(x) = \frac{1}{2} \left(x + \frac{1}{x} \right) - 1.$$

Lemma 1 (Nonnegativity and unique zero). *For all $x > 0$, $\text{defect}(x) \geq 0$, and $\text{defect}(x) = 0$ iff $x = 1$.*

Proof. Compute

$$\text{defect}(x) = \frac{1}{2} \left(x + \frac{1}{x} - 2 \right) = \frac{1}{2} \cdot \frac{(x-1)^2}{x} = \frac{(x-1)^2}{2x} \geq 0.$$

Equality holds iff $(x-1)^2 = 0$, i.e. $x = 1$. □

Theorem 2 (Law of Existence (scalar form)). *In the scalar cost model, existence is equivalent to defect-zero:*

$$x \text{ exists} \iff \text{defect}(x) = 0 \iff x = 1.$$

Proof. Immediate from the previous lemma. □

4. Derived Meta-Principle: “nothing cannot exist”

The RS meta-principle is expressed as a limit theorem about the cost of the boundary object $x \rightarrow 0^+$.

Theorem 3 (Derived MP in cost form).

$$\lim_{x \rightarrow 0^+} J(x) = \infty.$$

Proof. From $J(x) = \frac{1}{2}(x + x^{-1}) - 1$, the term x^{-1} diverges as $x \rightarrow 0^+$, hence the limit is ∞ . □

Definition 3 (“Nothing” as a cost boundary). *We use the symbol 0 as shorthand for the boundary $x \rightarrow 0^+$ (not an element of $\mathbb{R}_{>0}$). In RS cost language, “nothing” means “the vanishing-ratio boundary”.*

Corollary 1 (Nothing cannot exist). *“Nothing cannot exist” is the theorem that the boundary $x \rightarrow 0^+$ is excluded by infinite defect:*

$$(nothing) \not\models \text{defect} = 0, \quad \text{because} \quad \lim_{x \rightarrow 0^+} \text{defect}(x) = \infty.$$

Corollary 2 (Existence is forced (in the scalar model)). *There exists (and is unique) a defect-zero element, namely $x = 1$. Thus existence is witnessed internally by the cost structure:*

$$\exists! x > 0 \text{ such that } \text{defect}(x) = 0.$$

Proof. We have $\text{defect}(1) = 0$ and the zero is unique by the Law of Existence. \square

5. Ontology predicates in RS

The prior sections motivate three RS-native predicates: *exists*, *true*, and *real*.

5.1 Existence

Definition 4 (RS existence predicate). *Define*

$$\text{RSExists}(x) :\iff (0 < x) \wedge \text{defect}(x) = 0.$$

Theorem 4 (Uniqueness of RS existence (scalar form)). *For all $x > 0$, $\text{RSExists}(x)$ iff $x = 1$. In particular, there exists exactly one RS-existent scalar element.*

Proof. By the Law of Existence, $\text{defect}(x) = 0$ iff $x = 1$. \square

5.2 Truth as stability under recognition iteration

Truth in RS is not defined as “correspondence to a hidden thing-in-itself.” Instead, truth is the stability of a statement under repeated recognition.

Definition 5 (Recognition iteration (abstract)). *Let \mathcal{C} be a nonempty configuration space and let $\mathcal{R} : \mathcal{C} \rightarrow \mathcal{C}$ be an iteration operator representing one step of recognition-driven updating. Write \mathcal{R}^n for the n -fold iterate.*

Definition 6 (Stabilization of a predicate). *Let $P : \mathcal{C} \rightarrow \{\text{false}, \text{true}\}$ be a predicate and let $c \in \mathcal{C}$. We say P stabilizes under recognition iteration at c if there exists $N \in \mathbb{N}$ such that for all $n \geq N$,*

$$P(\mathcal{R}^n(c)) = P(\mathcal{R}^N(c)).$$

Definition 7 (RS truth predicate). *Let c_\star denote the RS-existent configuration (in the scalar model, $c_\star = 1$). Define*

$$\text{RSTrue}(P) :\iff P(c_\star) \wedge (P \text{ stabilizes under recognition iteration at } c_\star).$$

This is a definition, not a claim that every predicate stabilizes. The point is that RS identifies *truth* with what survives iterated recognition, rather than what can be asserted once.

5.3 Reality as existence plus discreteness

RS distinguishes “exists” from “real” by adding a discreteness condition. This makes “real” a stronger predicate than mere defect-zero.

Definition 8 (Discrete RS skeleton (one canonical choice)). *Let $\varphi := \frac{1+\sqrt{5}}{2}$ be the unique positive solution of $\varphi^2 = \varphi + 1$. Define a discrete multiplicative skeleton*

$$\mathcal{D} := \{\varphi^n : n \in \mathbb{Z}\} \subset \mathbb{R}_{>0}.$$

This is a simple stand-in for “discrete (algebraic in φ)”.

Definition 9 (RS reality predicate). *Define*

$$\text{RSReal}(x) :\iff \text{RSExists}(x) \wedge (x \in \mathcal{D}).$$

In the scalar existence model, $\text{RSExists}(x)$ already forces $x = 1 = \varphi^0$, so $\text{RSReal}(x)$ holds exactly at $x = 1$. The purpose of RSReal is not to add content to the scalar theorem, but to establish a predicate that can later be applied to richer configuration spaces where defect-zero does not collapse to a single scalar and where the discrete skeleton becomes a substantive constraint.

6. Summary

The ontological core can be stated without physics:

- *Existence* is defect-zero: $\text{RSExists}(x) \iff \text{defect}(x) = 0$.
- The *Law of Existence* is the uniqueness of the defect-zero element (scalar form: $x = 1$).
- The meta-principle “nothing cannot exist” is derived as $\lim_{x \rightarrow 0^+} J(x) = \infty$.

- *Truth* is stability of propositions under recognition iteration: $\text{RSTrue}(P)$.
- *Reality* is existence plus discreteness: $\text{RSReal}(x)$.

The result is a clean RS ontology: “exists,” “true,” and “real” are all cost/stability predicates, not physical primitives.