

SCALE COMPETENCE

A Theory of How Observers Stabilize Time

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Refinement Document: Cross-AI Synthesis

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The object has changed. You are no longer asking about time. You are asking about scale competence in finite observers. This is a different field of inquiry — one that doesn't compete with physics but sits alongside it, answering questions physics doesn't ask.

Preface: What This Document Is

This document records the refinement of the Observer-Scope and ISL framework through dialogue with two AI systems — ChatGPT and DeepSeek — conducted after the initial Zenodo publications (February 20, 2026). It is not a paper. It is a working synthesis: what the framework was, what the external analyses identified as correct and incomplete, and what the framework becomes when those analyses are integrated.

The central compression produced by this dialogue is:

Time is a competence.

Not a substance. Not an illusion. Not an emergent property of physics. A competence — something observers develop, lose, extend through tools, and pool across communities. This reframing changes what kind of inquiry the framework belongs to, and what questions it is equipped to answer.

The document proceeds in three parts: first, a record of what each AI analysis identified; second, the formal development of scale competence as the framework's new core object; third, the honest accounting of what remains incomplete.

Part One: What the Analyses Found

1.1 What ChatGPT Saw Correctly

The Object Has Changed

The framework is not a contribution to the philosophy of physics about the nature of time. It is a contribution to the theory of finite observers — specifically, a theory of how observers stabilize particular dynamical scales as usable time. This is a distinct field of inquiry that sits alongside physics rather than competing with it. Physics describes the causal structure of events. Scale competence theory describes the conditions under which a finite observer can use that structure meaningfully.

The Core Is Locked

The five elements ChatGPT identified as non-negotiable were already present in the published documents:

- Dynamical spectrum X : the universe's observer-independent scales
- Observer architecture: resolution ρ_a , memory M_a , horizon Θ_a , information gap $\Delta\Pi$, ISL ratio \mathcal{R}_a
- Memory as stabilizer: the ground that makes temporal comparison possible
- Forgetting as capacity control: the operator that keeps M_a below saturation
- Failure modes as diagnostics: collapse in any component identifies which dimension of observer architecture has degraded

The Compression Is Right

| *"Time is a competence." This is the one line that holds everything.*

A competence is something that can be developed, degraded, extended through tools, pooled across multiple agents, measured in principle, and compared across observers or species. None of these operations are available if time is treated as a substance or dimension. All of them become available under the competence framing.

The Canonical Form

ChatGPT proposed the following formalization, which integrates cleanly with the existing ISL and Scope Theory apparatus:

$$\Sigma_a(s) = f(\rho_a(s), M_a(s), \Theta_a, \Delta\Pi(s), \mathcal{R}_a(s))$$

The observer's scale competence at scale s is a function of five architectural components. The stabilization rule:

Observer stabilizes scale s as effective time $\Leftrightarrow \Sigma_a(s) \geq \Sigma_{\text{threshold}}$

Below threshold: events at scale s appear random (gap too large), surprising (no memory match), fragmented (horizon too short), or unstable (ISL violation). Above threshold: events become ordered, predictable, meaningful.

The Warning

Do not say: 'The universe is an observer.' The cosmological analogy — bounce as scale stabilization — is powerful, but it must be clearly marked as analogy unless the framework is prepared to defend that the universe has memory in the same sense observers do. The axioms (Paper I) permit but do not require that interpretation. For the scale competence paper, the levels must remain clearly separated.

1.2 What DeepSeek Identified

Structural Honesty

DeepSeek's analysis was the most useful for identifying what the framework actually is versus what it risks appearing to be. Several specific pushbacks deserve direct engagement:

On the JWST Framing

The tension between early massive galaxies and Lambda-CDM is real. But the cosmological community has proposed multiple explanations that do not require bounce cosmology: revised dust attenuation corrections, AGN feedback models, updated star formation efficiency estimates. The documents in their original form frame the JWST observations as confirmation. They should be framed as consistent with — a test, not a fingerprint already detected. This distinction matters for credibility.

On the Three-Layer Separation

The framework contains three things that need to remain clearly distinguished:

Layer	Status	What It Needs
Phenomenological / philosophical account of observer-dependent time	Complete and defensible	Peer review in philosophy of mind or philosophy of physics
Axiomatic framework for finite information-bearing systems (Paper I)	Internally consistent	Independent mathematical review of the axioms and proofs
Cosmological application with quantitative predictions	Speculative — awaiting numerical development	Specific number: galaxy count floor at specific redshift and mass threshold

The documents sometimes allow these layers to blur — presenting the whole as more unified and confirmed than it is. The strongest version of the framework keeps them explicitly distinct, with each layer standing on its own terms.

On the α Derivation

The claim to derive $\alpha^{-1} = 137.036$ from $\Phi = 120$ and $\eta = 9$ with zero free parameters would be among the most significant results in theoretical physics in decades. If correct, it belongs in a peer-reviewed journal, not Zenodo self-publication. If the derivation

contains a gap, publishing it prominently risks undermining the work that genuinely holds up. This claim requires independent review before being presented as a result.

The Honest Structural Question

The strongest version of this project keeps the three layers clearly distinct — each layer standing on its own terms. Not more synthesis. What would strengthen it is a single, narrow, quantitative prediction from Paper III that could be checked against existing JWST data — a specific number, a specific redshift range, a specific mass threshold.

Part Two: Scale Competence — The Formal Development

2.1 The Dynamical Spectrum

The universe presents a spectrum of dynamical scales $\{s_i\}$ — from Planck time ($\sim 10^{-43}$ s) through atomic, biological, ecological, geological, cosmological, to the Hubble timescale ($\sim 4 \times 10^{17}$ s). Each scale corresponds to a characteristic interval or frequency of recurring structure. These scales exist independently of any observer.

The spectrum is not uniformly accessible. Different physical, biological, and cognitive processes operate at different scales. An observer does not interact with all scales simultaneously — they interact with a subset, determined by their architectural constraints. The question scale competence theory asks is: what determines which scales become usable as time for a given observer?

2.2 Observer Architecture — The Five Components

Every finite observer a is characterized by five components that jointly determine their competence at any given scale:

1. Resolution $\rho_a(s)$

The ability to distinguish events at scale s . Resolution is bounded by physical constraints (sensory limits, measurement apparatus) and cognitive constraints (discrimination thresholds, attention bandwidth). An observer with insufficient resolution at scale s cannot detect the events that scale presents — they are below the noise floor.

2. Memory $M_a(s)$

Stored patterns of past events at scale s , soaked in emotional flavor from the context of original storage. Memory is not a neutral archive: it is the emotional substrate that colors all incoming events before conscious processing begins. Without memory at scale s , there is no before against which to measure now — the temporal ruler has no other end to hold.

Memory is dynamic: it accumulates through experience, fades through forgetting, is restructured by new events, and carries different emotional charge at different stages of

processing. The same event, recalled a week later versus a year later, has different memory state M_a — and therefore participates differently in temporal comparison.

3. Horizon Θ_a

The temporal window $[t, t + \theta_a]$ over which events can be held in active comparison. Horizon is a hard constraint: events outside the window cannot be compared to events inside it. A species whose horizon is measured in seconds cannot use geological time as effective time — the scale exceeds the comparison window by many orders of magnitude.

Horizon can be extended through tools (written records, clocks, calendars) and through internalization of cultural representations of extended scales. The development of human civilization is partly a history of horizon extension.

4. Information Gap $\Delta\Pi(s)$

The deficit between what nature presents at scale s and what the observer's perception operator can receive:

$$\Delta\Pi(s) = I(X; \Pi^*) - I(X; \Pi_a)$$

When $\Delta\Pi$ is large at scale s , events at that scale arrive as incomprehensible, apparently random, without structure. The order is present in X . It is absent from the observer's received information. This is not a property of nature — it is a property of the gap between nature and the observer's current architecture.

5. ISL Ratio $\mathcal{R}_a(s)$

The cost per unit capability at scale s :

$$\mathcal{R}_a(s) = T_a(s) / C_a(s)$$

With stability condition $d\mathcal{R}/dt \leq 0$. When ISL ratio is rising at scale s , the observer is expending more resources per unit of temporal capability — they are operating unsustainably at that scale. This produces temporal instability: the observer's grip on scale s becomes unreliable, events appear at irregular intervals, patterns fail to cohere.

2.3 The Stabilization Rule

An observer stabilizes scale s as effective time if and only if all five components are above threshold simultaneously:

$$\Sigma_a(s) = f(\rho_a(s), M_a(s), \Theta_a, \Delta\Pi(s), \mathcal{R}_a(s)) \geq \Sigma_{\text{threshold}}$$

This is a conjunction, not a sum. Strength in four components cannot compensate for failure in the fifth. An observer with vast memory at scale s but insufficient resolution still cannot stabilize that scale. An observer with perfect resolution but no horizon cannot compare events across scale s . Each component is necessary.

Failure Signatures

Each component produces a distinctive failure mode when it falls below threshold:

Component Below Threshold	Phenomenological Signature	Example
$\rho_a(s)$ too low	Events at scale s are invisible or undifferentiated	Human perception of Planck-scale events
$M_a(s)$ absent	Events arrive without context; no before, no after; each moment isolated	Severe anterograde amnesia; first encounter with a new scale
Θ_a too short	Events cannot be held in comparison; scale feels fragmented, incoherent	Species with second-scale horizon encountering geological time
$\Delta\Pi(s)$ too large	Events appear random, chaotic; apparent dice-rolling	Pre-scientific encounter with quantum phenomena
$\mathcal{R}_a(s)$ rising	Temporal instability; patterns decohere; scale becomes unreliable	Cognitive overload; institutional collapse at a scale

2.4 Growth and Failure

Competence at scale s can expand through several mechanisms:

- Learning: increasing $M_a(s)$ through repeated exposure, building pattern libraries at scale s
- Tool-building: extending ρ_a through instruments (microscopes, telescopes), extending Θ_a through recording and calendar systems
- Collaboration: pooling scale competence across multiple observers, accessing scales none could stabilize alone
- Forgetting: clearing saturated memory via D_a , maintaining $\Delta\Sigma > 0$ to allow continued expansion

Competence collapses when any component degrades below threshold. These collapses are diagnostic — they tell us which dimension of the observer's architecture is failing. Trauma may corrupt M_a at certain scales, making those scales appear unreliable or absent. Cognitive overload raises \mathcal{R}_a until the ISL stability condition fails. Grief or anesthesia may suppress ρ_a at certain scales, narrowing the effective spectrum.

2.5 Implications

The scale competence framework generates several consequences that distinguish it from standard treatments of time:

Multiple effective times coexist

Different observers stabilize different subsets of the dynamical spectrum as effective time. A mayfly and a geologist and a cosmologist do not share effective time — they share the physical universe but stabilize different scales from it. This is not relativism about the universe. It is precision about which portions of the universe's order each observer can use.

No single true time

There is no scale that is intrinsically the time scale. The Planck time is not more fundamental as a time than the Hubble time — they are simply different elements of the dynamical spectrum, accessible to different observer architectures. The human preference for scales in the range of seconds-to-decades reflects our biological and cognitive architecture, not a feature of the universe.

Time can be taught and lost

If time is a competence, it can be developed through education, lost through injury or cognitive decline, extended through tool-building, and pooled through social structures. This generates testable predictions about developmental psychology (when do children stabilize which scales?), cognitive neuroscience (what impairs temporal competence and how?), and social epistemology (how do communities extend temporal reach beyond individual horizons?).

Randomness is a gap property, not a world property

Events appear random at scale s precisely when $\Delta\Pi(s)$ is large — when the observer's information capacity at that scale is insufficient to receive the order that is present. Reducing $\Delta\Pi(s)$ through learning, tool-building, or collaboration progressively reveals order where chaos appeared. The dice were never in nature. They were always in the gap.

Part Three: What Remains Incomplete

3.1 The Functional Form of $\Sigma_a(s)$

The canonical form $\Sigma_a(s) = f(\rho_a, M_a, \Theta_a, \Delta\Pi, \mathcal{R}_a)$ is a scaffold, not a theory. The functional form f is unspecified. The threshold $\Sigma_threshold$ is unspecified. Without these, the framework generates qualitative predictions but not quantitative ones. This is the primary open problem.

Three candidate functional forms suggest themselves:

- Minimum: $\Sigma_a(s) = \min(\rho_a, M_a, \Theta_a, 1/\Delta\Pi, 1/\mathcal{R}_a)$. The competence is limited by the weakest component. Threshold failures are sharp.
- Product: $\Sigma_a(s) = \rho_a \cdot M_a \cdot (1/\Delta\Pi) \cdot (\Theta_a/s) \cdot (1/\mathcal{R}_a)$. Components multiply; deficiency in any collapses the product. Threshold failures are smooth.

- ISL-integrated: $\Sigma_a(s) = C(\Delta) / T$ where C is the ISL cost functional and the gap Δ aggregates all five components. This would connect directly to the existing ISL framework.

Determining which functional form is correct requires either axiomatic derivation from first principles or empirical measurement in a domain where scale competence can be operationalized (developmental psychology, comparative cognition, or possibly AI systems).

3.2 The Cosmological Prediction

The bounce cosmology predicts a floor in galaxy number density at high redshift rather than the exponential decline to zero predicted by Lambda-CDM. To be scientifically useful, this needs to be:

- A specific predicted number density at a specific redshift and mass threshold
- Derived through the standard structure formation machinery (transfer function, growth factor, halo mass function) applied to the bounce initial conditions
- Presented as a test rather than as confirmation of already-detected anomalies

This is the work of Paper III, which remains unfinished. Until that work is complete, the cosmological layer of the framework should be presented as a prediction under development, not as a result.

3.3 The α Claim

The claim to derive $\alpha^{-1} = 137.036$ from $\Phi = 120$ and $\eta = 9$ requires independent mathematical review before being presented publicly as a result. The quantity $\Phi = 120$ appears to encode a specific information-geometric identity, and $\eta = 9$ appears to be a constraint on the closure group structure. The derivation should be presented with full algebraic detail so that a physicist familiar with information geometry and group theory can verify or falsify it. At present, the claim is asserted rather than demonstrated.

3.4 Peer Review

The phenomenological and philosophical work — observer-generated time, randomness as gap property, forgetting as architectural feature — is ready for submission to a philosophy of physics or philosophy of mind journal. It does not require the cosmological results to be confirmed. It stands on its own as a contribution to the epistemology and phenomenology of temporal experience.

The axiomatic framework (Paper I) is ready for submission to a philosophy of science or foundations of physics journal. The seven axioms are clearly stated, the theorems follow, and the distinction between what the axioms establish and what they leave open is honest.

The ISL technical framework requires review by someone with expertise in information geometry and possibly quantum gravity (for the cosmological application). The Zenodo publication establishes priority but does not constitute peer review.

Synthesis: Where the Framework Stands

Component	Status	Next Step
Time as observer-generated through memory (phenomenological)	Complete and defensible	Submit to philosophy of mind or philosophy of physics journal
Axiomatic framework: saturation, Refusal, residual correlations (Paper I)	Internally consistent	Submit to philosophy of science journal; seek independent mathematical review
Observer-Scope synthesis (ISL + phenomenology)	Complete as synthesis	Present as standalone document; seek review from cognitive scientists
Scale competence formalization $\Sigma_a(s)$	Scaffold — functional form unspecified	Determine functional form through axiomatic derivation or empirical operationalization
ISL information-geometric derivation	Technically developed; requires expert review	Seek review from information geometry specialist
α derivation from first principles	Asserted; not yet demonstrated with full derivation	Present full algebraic derivation; seek independent verification
Cosmological application: bounce + JWST prediction	Speculative; prediction not yet numerically precise	Complete Paper III with specific number density curve at specific redshift
Scale competence as standalone paper	Ready to write	Write in 1-2 weeks as entry point for philosophers, cognitive scientists, AI researchers

Closing: What the Chair Holds

The observer is, in moments of genuine surprise, simply not yet large enough to receive it. And they are built — wisely, mercifully — to forget enough of the past that they remain willing to try.

This sentence has appeared, in some form, at the end of every document in this program. It is the moral center of the framework. The universe is not indifferent. The observer is finite. The gap between them is real, measurable, and closeable.

What the cross-AI dialogue has done is clarify which parts of that claim are currently demonstrated and which remain to be shown. The phenomenological core is demonstrated. The axiomatic structure is demonstrated. The formal connection between them, in the Observer-Scope synthesis, is demonstrated.

What remains is the specification of scale competence as a formal object with a determined functional form — and the quantitative cosmological prediction that would give the framework an empirical anchor.

The chair is real. The sitting is the next step.

S.B., February 2026

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