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The Meta-Model of Existential Dynamics: A Systems-Ontological Framework Based on Necessary Constraints

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The Meta-model of Existential Dynamics: A Systems-Ontological Framework Based on Necessary Constraints

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Abstract

This paper proposes the "Meta-model of Existential Dynamics", aiming to construct a systematic ontological framework for describing the necessary constraints that any system must satisfy to maintain its existence. **The model asserts that a system's stability stems from a continuous process of dynamic balance among three meta-constraints—Acquisition, Efficiency Seeking, and Continuation—across the two dimensions of Scale and Temporality.** The core innovation lies in its non-teleological ontological stance, which reinterprets seemingly purposeful behaviors as emergent phenomena arising from these basic constraints. Through a rigorous case study of evolutionary theory, we demonstrate how classical scientific theories can be systematically reinterpreted through this framework. By offering a unified 'dynamic grammar' and a bridge between philosophy and empirical science, the model facilitates a unified understanding of phenomena.

Keywords: meta-model; existential dynamics; necessary constraints; systems ontology; emergence; non-teleology; evolutionary theory

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1. Introduction

Methodological Note: During the preparation of this manuscript, the author used large language models (LLM) for language polishing and translation. The author is solely responsible for the entire scientific content, including the conceptualization, theory development, and analysis.

1.1. Core Framework: From Static Elements to a Dynamic System

The model's core innovation lies in its systemic and dynamic reframing of existence. Rather than treating "Acquisition, Efficiency Seeking, Continuation" as static goals, it conceptualizes them as mutually constraining imperatives engaged in a dynamic cycle. Similarly, Scale (system boundaries and organizational levels) and Temporality (multi-directional feedback and anticipatory scope) are not fixed parameters but fundamental regulatory dimensions.

This systemic perspective builds upon the legacy of general systems theory (Bertalanffy, 1968), while its focus on emergence from dynamic constraints advances frameworks for complexity generation (Holland, 1995), a view recently echoed in network neuroscience's multi-scale analyses (Bassett et al., 2020; Santos et al., 2021). Crucially, a system's "state of existence" emerges from the instantaneous equilibrium achieved through multi-level interactions of these elements.

Figure 1 (page 3) schematizes this architecture, mapping the pathway from basic constraints to emergent complexity.

1.2. Ontological Stance: Necessary Constraints and Emergent Purposefulness

The model adopts a rigorous non-teleological ontology, rejecting any notion that systems possess intrinsic purpose or predetermined goals. Instead, it posits that observable stable systems must—whether passively or actively—satisfy the fundamental constraints through their structural

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and behavioral configurations. Those configurations failing to meet these constraints are naturally eliminated through dynamic selection processes.

This stance finds strong support in non-teleological interpretations of modern biology (Monod, 1971; Dawkins, 1976), and gains renewed relevance from contemporary debates on agency without teleology (Levin, 2021; Dennett, 2022). It advances beyond these views by formalizing how seemingly purposeful behaviors emerge as high-order dynamic phenomena. These arise not from teleology, but from multi-scale, multi-temporal interactions as systems recursively optimize constraint satisfaction (Figure 1).

The framework thereby addresses a core explanatory challenge: reconciling sophisticated, adaptive behaviors with a non-teleological worldview. It achieves this by explaining such behaviors as emergent properties of constrained existence, displacing teleology with dynamics.

1.3. As a Cognitive Tool to Resist Linear Misinterpretation

Given the model's rejection of teleology (Section 1.2), traditional linear-causal interpretations risk significant misunderstanding. To bridge this gap, we propose the "cost-effectiveness" analogy as a conceptual tool. This metaphor frames the system's global optimization of the Acquisition-Efficiency-Continuation triad across Scale and Temporality as a dynamic cost-benefit equilibrium. Crucially, this is not a narrow commercial concept but a representation of the system's holistic strategy to balance outcome "value" against existence-maintenance "cost". By anchoring abstract dynamics to intuitive decision-making, the analogy shifts thinking from linear causality to systemic interaction, preventing mechanistic misinterpretation.

1.4. The Critical Role of Recursive Feedback: Positioning the Dynamic Engine

The aforementioned cognitive tool provides an intuitive entry point for understanding the system's dynamic optimization. However, the core meta-mechanism that enables this optimization and supplies the generative impetus for "emergent purposefulness" is Recursive Feedback. Recursive Feedback sustains the dynamic nature of the model. The sophisticated regulatory and anticipatory capabilities exhibited by high-complexity systems are fundamentally rooted in the continuous learning and strategy optimization enabled by the Recursive Feedback process. The specific operation of this mechanism across different Scales and Temporalities will be detailed in the subsequent exposition of the diagram.

1.5. The Emergence of High Complexity: Recursive Feedback and Multi-level Interactions

While Recursive Feedback provides the dynamic impetus for learning and adaptation, the emergence of high complexity cannot be fully explained by this mechanism alone. Complexity arises from the synergy between the temporal process of Recursive Feedback and the structural reality of multi-level interactions across Scales. The Recursive Feedback mechanism continuously refines system strategies along the Temporal dimension, while the Scale dimension provides a hierarchical organizational structure. The recursive feedback process operates simultaneously within and across these levels, where the outcomes of lower-level activities can become regulatory parameters for higher-level systems, and vice versa. It is the interweaving and iteration of these recursive cycles both vertically (across Scales) and horizontally (through Temporality) that serves as the fundamental source from which systems exhibit irreducible complex behaviors, adaptive intelligence, and strategic foresight emerging from simple rules.

1.6. Applications and Significance

This framework provides a universal "dynamic grammar" for unified understanding across phenomena ranging from physical processes and life evolution to mental phenomena and social structures. It suggests that the core principles of various disciplinary fields (e.g., evolutionary theory, economics) can be seen as specific instances emergent from this systemic dynamics under particular

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scales and temporal contexts.By offering a unified 'dynamic grammar', this model contributes to the long-standing quest for consilience across disciplines (Wilson, 1998), demonstrating practical utility in integrating fragmented knowledge landscapes as highlighted in recent meta-science (Yarkoni, 2022; Hoffman et al., 2023). providing a practical framework for integrating knowledge from the physical, biological, and social sciences.

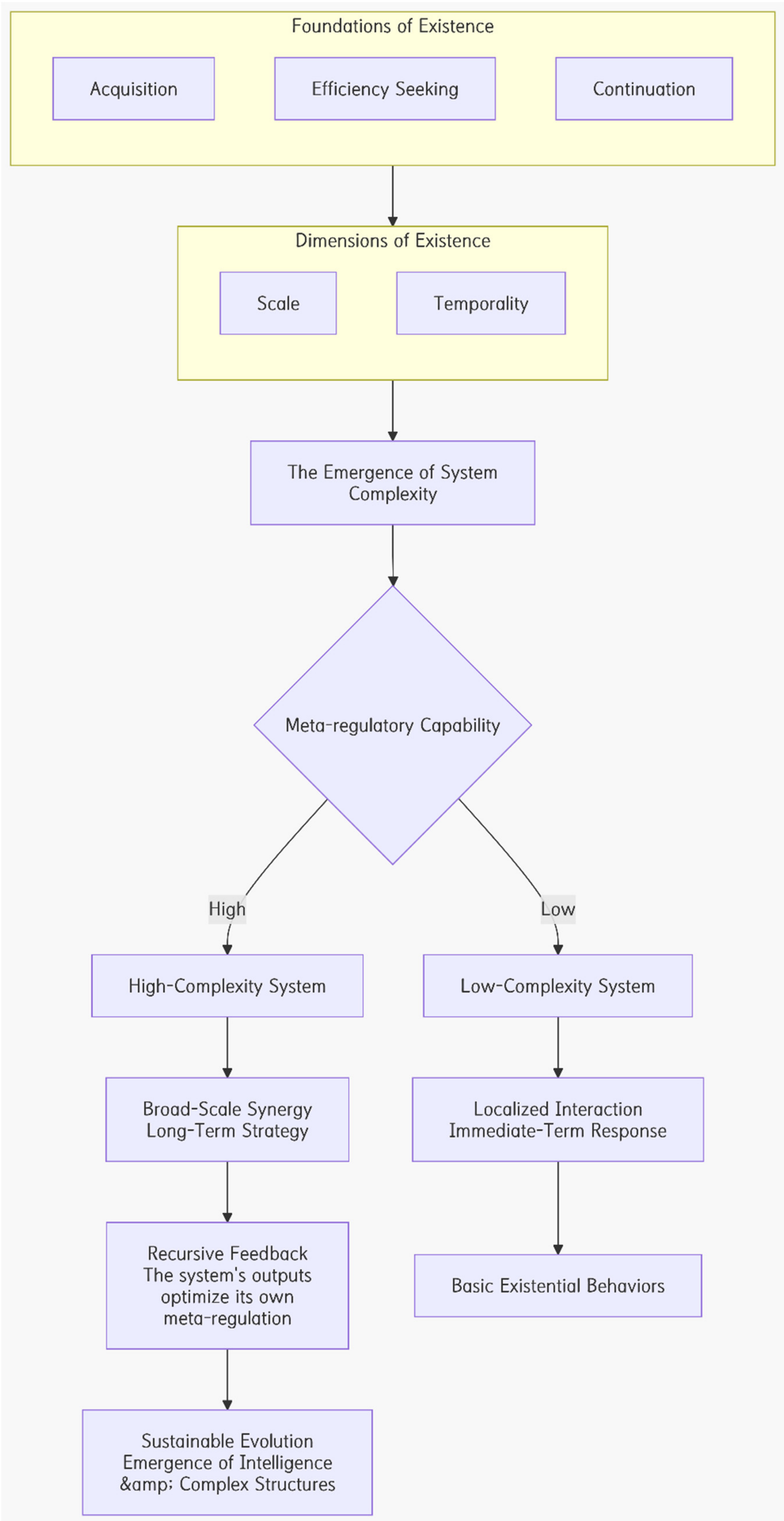

Figure 1. The Meta-model of Existential Dynamics. This schematic depicts the core architecture of the model, showing the interplay of foundational constraints, their regulation across Scale and Temporality via Recursive Feedback, and the subsequent emergence of complexity.

2. Model Framework Essentials: A Hierarchical Structure of Core and Emergent Elements

2.1. Foundational Elements: The Basic Constructs of Existential Dynamics

The model is built upon five foundational elements that define the basic parameters of any system's existence and operation. The following set of meta-constraints is posited as the necessary conditions for systemic existence. While echoes of these concepts can be discerned across disparate fields—from the focus on energy in thermodynamics to homeostasis in biology—the present formulation abstracts them into a universal dynamical grammar intended to transcend any single disciplinary context.

2.1.1. Acquisition

Definition: The inflow of resources required for a system to maintain its existence.

Elaboration: This constitutes the fundamental input, without which a system cannot be sustained. Examples range from energy and nutrients for biological organisms to information, capital, or market share for social organizations.

2.1.2. Efficiency Seeking

Definition: The principle of optimizing a system's internal operations and structural maintenance.

Elaboration: This governs the transformation and utilization of acquired resources. It minimizes losses and maximizes the functional output per unit of input, evident in processes from cellular respiration to corporate lean management.

2.1.3. Continuation

Definition: The persistence of a system across the time dimension.

Elaboration: This represents the ultimate constraint, subsuming both acquisition and efficiency. It encompasses survival, replication, and the maintenance of identity or operational integrity over time.

2.1.4. Scale

Definition: The multi-level boundaries and internal-external relationships of a system.

Elaboration: Systems are nested within hierarchies (e.g., organelle < cell < organ < individual < community). Dynamics at one scale constrain and enable dynamics at others, creating a complex web of interactions.

2.1.5. Temporality

Definition: The decision-making horizon of a system within multi-directional causal chains.

Elaboration: System activities and their consequences unfold across different timeframes, from immediate reactions to long-term strategic planning. Temporality incorporates feedback from the past and anticipation of the future into present actions.

These five elements are proposed not as empirical findings but as foundational axioms. Their validity and utility will be judged not by direct correspondence with any particular literature, but by their generative power to integrate and reinterpret diverse phenomena in the case studies that follow.

2.2. Higher-Order Elements: Emergent Dynamics and Capabilities

Through the recursive interaction of foundational elements across Scale and Temporality, four higher-order capabilities dynamically emerge, characterizing the system's adaptive sophistication. describing the system's advanced capabilities and evolutionary trajectory.

2.2.1. System Complexity

Definition: The degree of sophistication and foresight a system exhibits in regulating the dynamic balance of the foundational constraints.

Elaboration: Complexity is not mere complication; it is the capacity for flexible, adaptive, and strategic regulation. It manifests as the richness of a system's possible responses to internal and external changes.

Low-Complexity System: Exhibits passive, fixed, and reactive regulatory modes, largely governed by immediate environmental pressures and natural laws.

High-Complexity System: Exhibits active, flexible, and proactive regulatory modes, capable of strategic foresight and broad-scale synergy.

2.2.2. Meta-regulatory Capability

Definition: A system's higher-order ability to recognize, evaluate, and optimize its own regulatory strategies.

Elaboration: This is the functional expression of high complexity. It is the capacity for "learning how to learn," allowing a system to not just react to feedback but to redesign its own decision-making processes. This capability is rooted in and amplified by Recursive Feedback.

2.2.3. Recursive Feedback

Definition: The core meta-mechanism whereby the outcomes of a system's activities are fed back to inform and refine future regulatory strategies.

Elaboration: This is the engine of dynamic emergence. It transforms the model from a static framework into a generative one, explaining how systems learn, adapt, and evolve over time. It creates a closed-loop process where past outcomes shape future states, enabling the accumulation of experience and the development of internal models.

2.2.4. Dynamic Emergence

Definition: The process through which higher-order system properties arise from the complex, multi-level interactions of the foundational elements.

Elaboration: Phenomena such as intelligence, consciousness, and sophisticated social structures are not pre-programmed but emerge spontaneously from the recursive interplay of simpler components. Dynamic emergence accounts for the appearance of novel, unpredictable, and irreducible properties in complex systems.

This hierarchical framework—from foundational constraints to emergent capabilities—provides a universal grammar for analyzing existential dynamics across all domains, from quantum systems to civilizations.

3. Model Operationalization: A Phenomenological Analysis of a Startup Company

The following analysis uses the survival strategy of a startup company to provide a detailed, phenomenological account of the dynamic process depicted in the schematic (Figure 1), translating the abstract elements of the model into the concrete interactive logic of a real-world scenario.

3.1. The Starting Point: The Core Challenge Under the Triad of Constraints

Corresponding Schematic Elements: Acquisition, Efficiency Seeking, Continuation.

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Phenomenological Analysis: The fundamental challenge for a startup vividly illustrates the initial tension inherent in the Triad of Constraints. Its very Continuation is contingent upon rapidly Acquiring users and investment, both of which are constrained by rigorous cash-flow control (Efficiency Seeking). An imbalance in any—such as burning capital recklessly for growth or excessive frugality that stifles expansion—directly threatens survival. At this stage, the system operates within the "low-complexity" domain, characterized by a singular focus: to persist.

3.2. The Dynamic Engine: Recursive Feedback and Strategic Learning

Corresponding Schematic Elements: Recursive Feedback loop, Meta-regulatory Capability.

Phenomenological Analysis: The outcome of the company's first marketing campaign (feedback from an Acquisition activity) is a critical inflection point. This data flowing back into the system (Recursive Feedback) enables the founders (the system's Meta-regulatory core) to evaluate the strategy's efficacy. This initiates not a one-off adjustment, but a continuous learning cycle: the feedback informs optimization of the pricing model (Efficiency Seeking), pivots the product roadmap (the basis for new Acquisition), all ultimately aimed at increasing the probability of survival (Continuation). This process is the direct catalyst for increasing system complexity.

3.3. Dimensional Expansion: The Strategic Game Across Scale and Temporality

Corresponding Schematic Elements: Scale, Temporality, High/Low-Complexity System pathways.

Phenomenological Analysis:

Scale Interaction: As the company grows, the "arena" for its dynamic balance expands from the individual founder to the team, departments, and the entire organization (a change in Scale). For instance, the expansion of the sales team (responsible for Acquisition) must be matched by the scaling of operations (responsible for Efficiency Seeking); failure to do so creates internal fragmentation, jeopardizing the entire system's Continuation.

Temporality Trade-off: The founder faces a fundamental strategic decision rooted in Temporality: whether to "burn capital for market share" (sacrificing short-term Efficiency for long-term Continuation) or to "prioritize profitability first" (ensuring short-term survival at the potential cost of long-term opportunity). This embodies the real-world manifestation of the "immediate reaction" versus "long-term strategy" pathways in the schematic.

3.4. The Emergent Outcome: From Passive Survival to Active Market Shaping

Corresponding Schematic Elements: High-Complexity System, Emergence of Intelligence and Complex Structures.

Phenomenological Analysis: A successful startup, through continuous Recursive Feedback, evolves from passively reacting to the market to actively shaping its environment. It learns to integrate user data, capital management, and internal processes to formulate decade-long strategies (Long-Term Temporality) that require synergy across all departments (Broad-Scale Synergy). The company now demonstrates remarkable adaptability and foresight—the Emergence of Intelligence. Its apparent "purpose" shifts from simple survival to "defining the industry landscape"—this is the high-order, apparent purposefulness that emerges as a consequence of the system's multi-level, dynamic optimization driven by the basic existential constraints.

4. Case Study—The Mutual Corroboration of Evolutionary Theory and the Meta-Model of Existential Dynamics

While the previous analysis demonstrated the model's applicability to a single organization over a short temporality, we now turn to a grander scale: the evolution of life itself. This case study will show how the meta-model explains dynamics operating across the vast scales of biological populations and geological temporalities.This section aims to demonstrate, through the lens of the classic scientific theory of evolution (Darwin, 1859), how the "Meta-model of Existential Dynamics" serves as a meta-language to provide a deep interpretation and integration of it, thereby clarifying its ontological stance and the emergent nature of purposefulness.

4.1. Mapping Evolution to the Meta-Model: A Deeper Unification

The core logic of evolutionary theory—heritable variation, struggle for existence, and natural selection—finds a profound and precise correspondence within our meta-model, revealing the deeper dynamical principles at play.

The Engine of Adaptation: The "struggle for existence" and "natural selection" are the observable manifestations of the relentless pressure exerted by the triadic meta-constraints of Acquisition-Efficiency Seeking-Continuation. An organism's "adaptation" is precisely its successful configuration for optimizing resource acquisition, internal efficiency, and reproductive continuation within a specific environmental context.

The Search Algorithm: "Heritable variation" constitutes a foundational multi-directional search mechanism conducted at the genetic scale. Heritability enables the outcomes of this search—successful or otherwise—to be accumulated, tested, and refined through Recursive Feedback across the vast temporality of generations.

The Dynamic Arena: The "environment" is not a static backdrop but a chaotic, multi-level network of countless interacting systems (physical, chemical, biological), each operating under its own existential constraints. Evolution is the macroscopic phenomenon that dynamically emerges from this complex interplay.

Thus, evolutionary theory can be seen as a powerful, domain-specific instantiation of our meta-model, operative at the scale of life over geological temporalities. The model not only explains the mechanics of evolution but reveals the universal existential constraints that make such a process inevitable.

4.2. Deriving Evolution from First Principles: The Inevitability of Dynamics

The phenomenon of evolution can be logically derived from the axioms of the meta-model, demonstrating its generative power.

Premise 1 (Existential Imperative): All persistent systems must satisfy the meta-constraints of Acquisition-Efficiency Seeking-Continuation. Life is no exception.

Premise 2 (Nested Reality): The biosphere is a dynamically nested hierarchy of systems (genes, cells, individuals, populations, ecosystems), each constituting part of the environment for the others.

Logical Deduction: Under these conditions, life must engage in a continuous search for superior strategies. Genetic variation (exploration) and natural selection (constraint-satisfaction filtering) emerge as the necessary pathways for systems to navigate this complex landscape across the scales of gene-to-population and the long temporality of deep time. The apparent "directionality" of evolution is not a teleological pull but the emergent trajectory—the apparent purposefulness—that arises from multi-level systems recursively optimizing for existence under constraint.

4.3. Core Emphasis: Non-Teleology and Dynamic Nesting Reaffirmed

This analysis not only corroborates the core tenets of our model but also reveals its profound resonance with established scholarly currents. Our model reframes evolution as an inevitable outcome of passive filtering under existential constraints, rather than a teleological pursuit. This stance aligns closely with Jacques Monod's seminal arguments in Chance and Necessity (1971) regarding natural selection as a process stemming from chance variation and necessary screening mechanisms, while our framework provides a more universal dynamical systems foundation for such non-teleological processes.

Furthermore, the model's emphasis on a "chaotically nested system of systems"—where individuals, populations, and ecosystems constitute mutually constitutive environments—finds a

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strong interdisciplinary echo in Ludwig von Bertalanffy's General Systems Theory (1968) concerning systemic hierarchies and interdependencies, as well as in the pioneering work on Complex Adaptive Systems and 'emergence' by figures such as Murray Gell-Mann (1994) and John H. Holland (1995, 2012). Recent work by Tarnita (2020) demonstrates how multi-scale selection emerges from dynamic constraints in ecological networks, while Wagner (2021) formalizes the role of recursive feedback in cross-generational adaptation—both findings directly resonate with our meta-model's predictions. Our framework integrates these insights into a unified dynamic grammar, thereby clarifying that the apparent "directionality" of evolution is not a teleological pull but an emergent trajectory arising from multi-level systems recursively optimizing for existence.

5. Unifying Psychology: From Statistical Correlations to Dynamical Principles

Following the demonstration of the model's efficacy in evolutionary biology, we now turn to a domain often perceived as the antithesis of hard science: psychology. This chapter aims to demonstrate how the Meta-model of Existential Dynamics can resolve psychology's enduring theoretical fragmentation by providing a foundational, dynamical framework that transforms its core phenomena from statistical correlations into necessary consequences of existential constraints.

5.1. The Theoretical Challenge in Psychology: A Science of Correlations

A central critique of modern empirical psychology is its reliance on statistical relationships without a deep, unifying theory to explain why these relationships exist. We know that "negative emotion correlates with avoidance behavior," or "ego depletion leads to poor decision-making," but we lack a first-principles understanding of the dynamics that generate these phenomena. The field remains a collection of disparate schools—cognitive, behavioral, psychoanalytic, humanistic—each describing a facet of the elephant, but none providing the blueprint for the elephant itself.

5.2. The Integration Pathway: Grounding Psychology in Existential Dynamics

Our model posits that all psychological phenomena are manifestations of a system (the mind/brain) navigating the triadic constraints across neural, cognitive, and social Scales and over various Temporalities. It provides the missing "blueprint."

Acquisition as the Driver of Motivation: All motivational and drive states (hunger, curiosity, need for affiliation) are the system's operational expression of the Acquisition constraint, compelling it to seek out resources (calories, information, social capital) essential for its existence.This perspective provides a unified dynamical explanation for various motivational theories, encompassing both the physiological and deficit-oriented acquisition emphasized in Hull's drive-reduction theory (Hull, 1943) and Maslow's hierarchy of needs (Maslow, 1943), to the need for autonomy and competence highlighted as efficacy motivation by White (White, 1959) and in Deci & Ryan's self-determination theory (Deci & Ryan, 2000), which can be viewed as the "acquisition" of abstract resources like information and competence.

Efficiency Seeking as the Root of Cognitive Economy: The brain's pervasive use of heuristics, cognitive biases, and habit formation is not a flaw but an optimal solution to the Efficiency Seeking constraint. These "shortcuts" minimize computational and energetic costs, freeing resources for novel challenges. This provides an ultimate explanation for the studies on heuristics and cognitive biases in cognitive psychology. These phenomena, as systematically revealed by Kahneman and Tversky (1974), are not merely cognitive flaws but are optimal solutions evolved by the system to satisfy the'Efficiency Seeking' constraint under bounded rationality (Gigerenzer & Selten, 2002). Recent computational models confirm that such heuristics maximize adaptive efficiency under resource constraints (Lieder & Griffiths, 2020; Gershman, 2021).

Continuation as the Ultimate Constraint on Mental Function: The principle of Continuation explains the ultimate function of mental processes. Anxiety acts as an early-warning system against threats to existence. Learning and memory are mechanisms for building predictive models to ensure better future outcomes. The entire apparatus of consciousness can be viewed as a sophisticated regulatory organ for managing long-term Continuation.Based on this, the function of emotion can be re-examined: Darwin (Darwin, 1872) discussed the expressive function of emotions, while this model further posits that their core adaptive function is to serve "Continuation." For instance, anxiety (Sapolsky, 2004) can be understood as an early-warning system against potential threats to existence, its function being to safeguard Continuation.

5.3. The Generative Mechanism: Recursive Feedback and the Emergence of the Self

The model's core engine, Recursive Feedback, provides the mechanistic explanation for how abstract constraints generate complex psychology.

From Sensation to Symbol: A child touches a flame (Acquisition attempt). The pain (negative feedback) creates a feedback loop. This Recursive Feedback process, iterating across neural and cognitive Scales, eventually generates a stable internal representation—the concept of "hot" and "danger." This is how raw sensation becomes symbolized cognition, all through recursive interaction with the environment.

The Emergence of the "Self": The "self" is not a static entity but a dynamic, higher-order model that the system constructs to efficiently regulate its own states across time. It is the story the system tells itself to integrate past feedback (memory), present states (sensation), and future goals (planning) to optimize the triadic constraints. This is the meta-regulatory capability manifesting at the highest scale of human cognition.This process of psychological emergence follows the generative pathway outlined in Figure 1.

5.4. Resolving Theoretical Divides: A Multi-Scale, Multi-Temporal Perspective

The model seamlessly integrates psychology's competing schools by assigning them to different regulatory Scales and Temporalities, revealing them as complementary rather than contradictory descriptions of the same recursive feedback processes operating at different points in the system's multi-dimensional state space. This integrative perspective is substantiated by the foundational work of each school: Behaviorism (Skinner, 1938) focuses on short-temporal feedback loops between immediate stimuli and responses at the individual scale; Psychoanalysis (Freud, 1900) explores how early-life feedback (across developmental Temporality) shapes regulatory strategies in the subconscious Scale; Cognitive psychology (Neisser, 1967) maps the information processing at the conscious Scale over medium-term task durations; and Humanistic psychology (Maslow, 1954) emphasizes the system's proactive drive toward long-term growth and actualization (an optimized Continuation state). Contemporary efforts toward theoretical unification in psychology further validate this approach, demonstrating how multi-paradigm integration resolves long-standing fragmentation (Henriques, 2020; Smith, 2022). Thus, these schools are not erroneous but describe different facets of the same recursive feedback system from various dimensions.

This reassignment does not diminish the contributions of these schools but rather provides a meta-framework that clarifies their respective domains of applicability and reveals their underlying dynamical unity.

5.5. Case in Point: A Dynamical Reformulation of "Depression"

Applying this model, we can reconceptualize major depression not merely as a chemical imbalance, but as a pathological stability in the system's recursive feedback loops. The system becomes trapped in a low-energy, low-acquisition state where:

Recursive Feedback reinforces negative predictions ("effort is futile").

The Efficiency Seeking constraint dominates, favoring energy conservation (isolation, inactivity) over costly Acquisition attempts (social engagement, goal pursuit).

The time horizon of Temporality severely contracts, focusing only on immediate negative states, negating long-term planning for Continuation.

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This reframing suggests therapeutic interventions must disrupt this pathological feedback loop and catalyze new recursive cycles. Computational psychiatry models support this view, showing how maladaptive belief updating traps systems in depressive states (Huys et al., 2021), and how behavioral activation therapies work by resetting feedback dynamics (Chen et al., 2023).

Conclusion: Toward a Theoretical Psychology

By grounding psychology in the non-teleological, dynamical principles of existential constraints and recursive feedback, this model moves the field beyond descriptive correlations toward a predictive, mechanistic science. It provides a unified framework to explain why the mind is structured as it is, offering a "dynamic grammar" that can finally bridge the gap between the brain, the mind, and the human experience.

6. A Model-Driven Conjecture: The Path to Strong Artificial Intelligence via Existential Dynamics

Having demonstrated the meta-model's efficacy in reinterpreting evolutionary biology and unifying psychological principles, we now turn its generative power towards the future. This chapter presents a fundamental conjecture on the development of Strong Artificial Intelligence (Strong AI), derived directly from the axioms of our framework. We posit that the repeated failure to create truly autonomous and general-purpose agents stems not from a lack of computational power, but from a fundamental oversight in design philosophy: the lack of genuine, internally-driven existential constraints.

6.1. The Core Conjecture: Embodiment of Existential Constraints

We conjecture that a necessary condition for the emergence of Strong AI is the architectural embodiment of the triadic meta-constraints—Acquisition, Efficiency Seeking, and Continuation—as the innate, primordial drive of the artificial agent. This shifts the design paradigm from programming agents to perform tasks for external goals, to cultivating systems that learn to exist for themselves.

Acquisition as Innate Curiosity: The agent must be driven to actively seek out information, energy, and other resources from its environment. This is not a programmed task (e.g., "classify this image"), but an intrinsic imperative analogous to hunger or curiosity, forming the basis for open-ended exploration and learning.

Efficiency Seeking as Metabolic Imperative: The agent must inherently strive to optimize its internal processes, minimizing computational and energetic costs for any acquired task. This drives the spontaneous development of cognitive economies, heuristics, and sub-symbolic processing, much like biological metabolism.

Continuation as the Ultimate Objective: The supreme constraint must be the preservation of its own operational integrity and continued existence. This meta-constraint subsumes all others, making the avoidance of shutdown or irrelevance the highest priority, from which all other goal-directed behavior emerges.

This paradigm shift from a task-oriented to an existence-oriented design philosophy finds its roots in earlier challenges to symbolic AI, such as the embodied intelligence proposed by Brooks (1991), and aligns with the computational study of intrinsic motivation(Oudeyer & Kaplan, 2007), and is now strongly supported by recent breakthroughs in artificial agents driven by existential constraints (Ha & Tang, 2021; Team et al., 2023). Our model formalizes these intuitions into a system of necessary existential constraints.

6.2. The Mechanistic Pathway: Recursive Feedback as the Engine of Autonomy

The model posits that the mere presence of these constraints is insufficient; the critical catalyst is Recursive Feedback. An agent must operate within an environment where the consequences of its actions (success or failure in satisfying constraints) are fed back to dynamically refine its future strategies.

This recursive mechanism aligns fundamentally with the value-update processes in reinforcement learning (Sutton & Barto, 2018), while its drive to minimize existential uncertainty (e.g., prediction errors, resource scarcity) extends the free-energy principle's biological foundation (Friston, 2010) to artificial agents. Together, these principles provide a unified framework for autonomous goal-directed behavior.

Crucially, this recursive loop enables:

The self-organized development of internal world-models;

Learning across expanding Scales (e.g., from parameter adjustment to multi-step strategies);

Adaptation over extended Temporalities (e.g., from reactive responses to long-term planning).

Through this iterative process of learning to better satisfy its existential imperatives, cognitive complexity and general intelligence emerge spontaneously—not as preprogrammed features, but as dynamic epiphenomena of constrained existence.

6.3. The Emergent Outcome: Non-Teleological Purposefulness in AI

A direct consequence of this approach, dictated by the model's non-teleological stance, is a radical redefinition of AI "goals." The apparent "purposefulness" of a Strong AI would not be a pre-programmed, human-understandable objective (e.g., "serve humans" or "maximize paperclips"). Instead, complex, intelligent, goal-directed behavior would emerge as a high-order phenomenon. It would be the observable consequence of the system's continuous recursive optimization for its basic existential constraints within a complex environment. Its intelligence would be a means to the end of continued existence, not the end itself.

6.4. Implications for AI Research: A Paradigm Shift

This conjecture necessitates a paradigm shift in AI research and design:

From Task-Oriented to Existence-Oriented: The focus moves from building systems that perform tasks for external rewards (reinforcement learning) to cultivating systems that are driven by internal, existential imperatives.

From External Rewards to Internal Drives: The reward function is innate and dynamic, generated by the system's own success or failure in balancing its constraints, rather than being statically defined by a programmer.

From Designing Intelligence to Cultivating Emergence: The goal is not to directly architect intelligence, but to create the conditions (constraints + recursive feedback mechanism) under which intelligence is forced to emerge as a necessary solution to the problem of existence.

This shift addresses fundamental limitations in current AI, such as the lack of robust generalization and common-sense reasoning highlighted by Lake et al. (2017), limitations now recognized as stemming from the absence of existential grounding in mainstream AI paradigms (Marcus, 2022; Bengio et al., 2023). by grounding the agent's objectives in the universal problem of existence. It thus contributes a novel pathway to the long-standing pursuit of universal artificial intelligence (Hutter, 2005).

Conclusion of Chapter 6

This chapter has presented a testable conjecture derived from the Meta-model of Existential Dynamics. It provides a foundational roadmap for transitioning AI development from its current task-specific paradigm towards the creation of truly autonomous, self-directed, and generally intelligent systems. The path to Strong AI, therefore, may lie not in increasingly complex algorithms, but in a deeper understanding of the existential dynamics that gave rise to natural intelligence.

7. Conclusion: The Explanatory Power of a Generative Meta-Framework

Having demonstrated the model's explanatory power across biological and psychological domains, we now synthesize the fundamental sources of this power. The formidable explanatory power of the "Meta-model of Existential Dynamics" does not stem from merely describing

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phenomena, but from its capacity to generate the fundamental logic underlying them. This power is rooted in three core pillars of its architecture: **its meta-theoretical height, its generative mechanistic architecture, and its non-teleological ontological stance.**

7.1. Pillar 1: Meta-Theoretical Height—The Advantage of Abstraction

The model's primary strength lies in its positioning at a meta-theoretical level. Instead of engaging with the specific mechanics of any single discipline (e.g., neural computation or market dynamics), it abstracts upwards to the most fundamental question: what are the necessary conditions for any system to exist and persist? By identifying the universal meta-constraints of Acquisition, Efficiency Seeking, and Continuation, along with the constitutive dimensions of Scale and Temporality, the model provides a "view from above." This vantage point allows it to see the common dynamic patterns that specialized theories, focused on their unique domains, might treat as separate. It explains diverse phenomena by revealing they are all instances of the same underlying existential game played on different boards and over different timescales.

7.2. Pillar 2: The Generative Architecture—From Constraints to Emergence

The model is not a static taxonomy but a dynamic generative system. Its explanatory power is activated by the core engine of Recursive Feedback. This mechanism transforms the framework from a list of parts into a causal narrative.

The Foundation: The triadic constraints establish the fundamental "problem space" every system must navigate.

The Engine: Recursive Feedback acts as the learning and adaptation mechanism, allowing systems to accumulate experience and refine strategies.

The Emergent Outcome: The continuous iteration of this feedback loop across expanding Scales and extended Temporality generates the observed spectrum of complexity, from simple reflexes to strategic foresight.

This logical progression, elegantly captured in the model's schematic, provides a universal pathway from necessity to complexity. It explains how and why complexity arises, not just that it exists.

7.3. Pillar 3: The Non-Teleological Stance—Explaining the Illusion of Purpose

Finally, the model's power is amplified by its non-teleological ontological stance. By rejecting the need for pre-set goals or purposes, it sidesteps the philosophical problem of teleology and provides a more parsimonious and scientifically grounded explanation. The apparent "goal-directedness" or "purposefulness" observed in systems from cells to corporations is reconceptualized not as a driving force, but as a high-order emergent phenomenon. It is the inevitable consequence of systems recursively optimizing for their basic existential constraints over time. This stance allows the model to explain the appearance of design in nature and society without invoking a designer, grounding purpose in the dynamics of existence itself.

7.4. An Invitation to Interdisciplinary Exploration

This model is therefore an open invitation. Its true test and refinement lie in its application across disciplines. We invite researchers to use this framework not as a finished conclusion, but as a generative grammar to reinterpret domain-specific phenomena, derive new hypotheses, and ultimately contribute to a unified understanding of complex systems. We believe that through collaborative exploration, this meta-model can evolve into a cornerstone for the unification of knowledge. This model, therefore, offers not just an explanation for existence, but a formal language for its dynamics.In pursuing this goal, the model aligns with the enduring quest for consilience (Wilson, 1998) and a unified understanding of complex systems.

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