Prepublication Draft

For Early Reader Feedback Only

KITCEY_2025-THE_HUMAN_PARADIGM_V1.8.5.DOCX

This working draft is unpublished and circulated for constructive comments.

Readers have permission to share it with colleagues who may provide thoughtful feedback.

Please do not cite or distribute beyond that purpose without the author's consent.

The Human Paradigm

An Integrated Framework of Nature, Consciousness, and Environment (NiCE) for Troubleshooting and Redesigning Individual Humans and their Systems

NiCE™

NATURE
CONSCIOUSNESS
ENVIRONMENT

Robert D Kitcey

Lernaean Research™

Las Cruces, New Mexico, USA

ORCID: 0009-0004-8679-9155

RKITCEY@HUMANPARADIGM.COM

Abstract

We propose a triadic framework—the Human Paradigm—in which human nature (N), consciousness (C), and environment (E) (NiCE) are inseparably interdependent. This model addresses the long-standing fragmentation of the human sciences by treating these domains not as isolated objects of study but as three co-evolving aspects of a single system (Kitayama & Park, 2010; Nisbett et al., 2001). By distinguishing constitutive (synchronic), causal (diachronic), and enabling (contextual) relations, the framework integrates insights from 4E cognition (Newen et al., 2018), niche construction and cultural evolution (Boyd & Richerson, 1985; Henrich, 2015), predictive processing and active inference (Friston, 2010; Hohwy, 2013), and developmental systems theory (Oyama et al., 2001).

A level-pluralist stance maps phenomenality to Integrated Information Theory (Tononi et al., 2016), access to Global Neuronal Workspace (Dehaene & Changeux, 2011), and metacognition to Higher-Order Thought (Rosenthal, 2011; Lau & Rosenthal, 2011), clarifying when these dimensions should dissociate or converge. We formalize triadic dynamics through state-space learning, hierarchical Bayesian models of cultural priors, active-inference policy selection, and explicit metabolic constraints (Sterling & Laughlin, 2015). A measurement program specifies primary and secondary markers for N, C, and E and yields six testable predictions, including multi-lever intervention synergy, sensitive periods, symbolic mediation, plasticity bounds, cultural priors shaping metacognition, and rituals as control policies (Donald, 1991; Iriki et al., 1996; Lazar et al., 2005; Tang et al., 2007).

To guard against overbreadth, the framework embeds pre-registered falsification criteria, multilevel designs, and incentive-compatible governance mechanisms (Zuboff, 2019; Han, 2015). The Human Paradigm is not a final theory but a call for pluralist integration: a common ground where philosophy, psychology, neuroscience, anthropology, and sociology can converge. Its promise lies in being both visionary and testable—predicting, failing, and improving by design—so that N, C, and E can be studied as one coupled system, guiding us toward lower load, clearer access, and richer affordances.

.

Contents

List of Tables

List of Figures

1. Introduction

The study of what it means to be human has long been fragmented across multiple disciplines, each illuminating a slice of the whole while leaving the integrated portrait under-specified. Neuroscience maps neural correlates, psychology investigates cognition and behavior, anthropology documents cultural variation, biology traces evolutionary origins, and philosophy interrogates the nature of consciousness and the self (Nagel, 1974; Block, 1995; Chalmers, 1996; Searle, 1997; Henrich, 2015). While each has made significant progress, the lack of integration across these approaches has limited our understanding of the human condition as a coupled system.

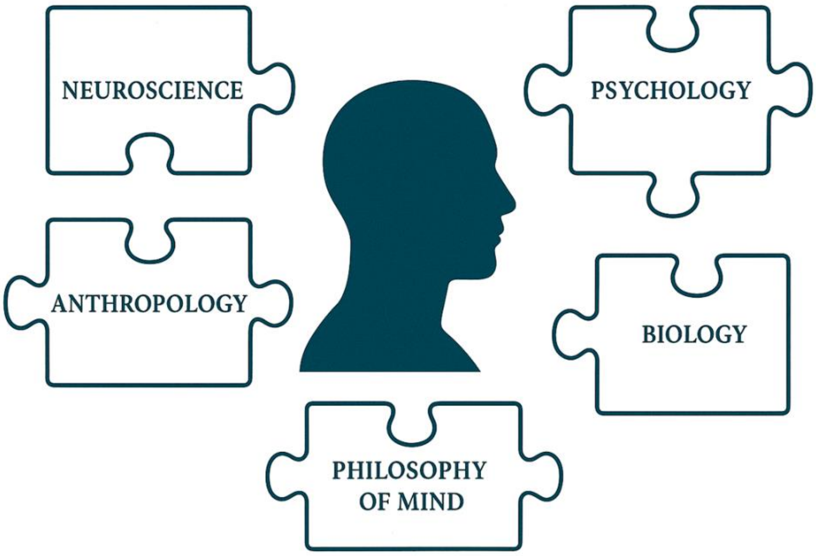


Figure 1 - The Challenge of Disciplinary Fragmentation

The study of human nature has been divided across multiple disciplines (Neuroscience, Psychology, Biology, Anthropology, Philosophy of Mind), each with distinct methods and concepts. The central human silhouette represents the integrated understanding that remains missing when these approaches operate in isolation. This fragmentation motivates the need for a unified framework that bridges disciplinary boundaries.

We then formalize the framework by encoding learning and development through state-space and hierarchical Bayesian models to capture skill acquisition and culture-specific priors, and by extending active inference with an energetic prior so that metabolic costs systematically bias policy selection (Sterling & Laughlin, 2015). This yields clear, recoverable behavioral signatures, physiological load measures, and metacognitive predictions. To move from theory to data, we specify a measurement program with primary and secondary markers across the triad (N/C/E) and articulate a portfolio of falsifiable predictions and designs.

Finally, because incentives and affordances co-constitute behavior with bodies and appraisals, we outline incentive architectures and a Triadic Implementation Protocol that align validated outcomes with the easiest available paths for actors (Zuboff, 2019; Han, 2015).

Triadic relationships at a glance

*We use "**NiCE**" to treat human **Nature (N)**, **Consciousness (C)**, and **Environment (E)** as a coupled system with three relation types:*

Constitutive (within-slice): *structural couplings that make a state what it is (e.g., neuromodulatory tone constraining workspace dynamics; institutional rules shaping available actions).*

Causal (across slices): *how present states update future states via learning, development, and environmental change (e.g., training-induced plasticity; policy changing incentives and habits over time).*

Enabling (contextual): *scaffolds and constraints that license or limit trajectories (e.g., cultural symbols, tools, and norms; biophysical budgets and plasticity envelopes).*

Nodes: *N = constraint priors, energy budgets, plasticity; C = phenomenal fields, global access/workspace, metacognition, goal-directed control; E = affordances, symbolic tools, institutions, developmental inputs.*

Edges (examples): *N→C capacity constraints; E→C task/meaning scaffolds; C→E policy/design; E→N developmental/epigenetic change; C→N training plasticity; N↔E niche construction.*

Empirical contract: *§§5–5.4 formalize this triad (state-space learning, hierarchical priors, active inference with energetic costs) and specify indicators, datasets, and falsifiers; the case studies in §3 test predicted couplings.*
*See **Fig. 8–9** for temporal and multilevel graphs.*

The **central thesis** of our framework is that *human nature, human consciousness, and the environment stand in relations of mutual constitution.*

- **Human nature** *provides the evolved capacities that make consciousness possible*;
- **consciousness** *provides the lived, narratively structured experience through which we engage with the world* (Nagel, 1974; McAdams, 2001; Bruner, 1991; Baumeister, 1991); and
- **the environment** *provides the constitutive context within which both nature and consciousness develop and operate*. None of these elements can be fully understood in isolation from the others.

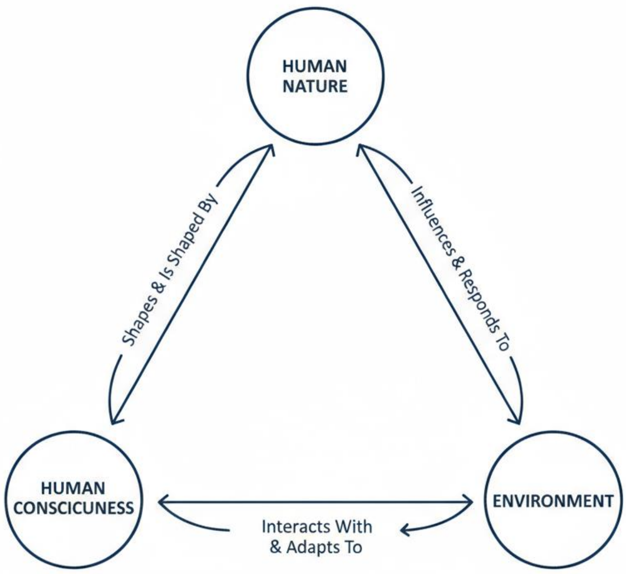


Figure 2 - The Human Paradigm

A triadic framework integrating Human Nature (N), Consciousness (C), and Environment (E). Bidirectional arrows indicate dynamic interactions and mutual constitution between all three components. Human Nature shapes and is shaped by both Consciousness and Environment, while Consciousness interacts with and adapts to the Environment, creating a system of mutual interdependence and co-evolution.

In this paper, we refine and extend our triadic framework in several key ways.

- First, we situate it within existing theoretical traditions, clarifying its conceptual foundations and novel contributions.
- Second, we provide conceptual clarifications regarding the nature of the relationships between the three corners of our triad, the integration of different theories of consciousness, and the operationalization of key concepts.
- Third, we develop explicit causal models that capture the dynamic interactions between nature, consciousness, and environment across multiple timescales.
- Fourth, we propose formal mathematical expressions that enhance the precision and testability of our framework.
- Fifth, we present a comprehensive empirical framework with specific predictions and measurement strategies.

- Finally, we discuss the ethical implications of our approach and its potential contributions to a more unified science of the human.

"We pre-register four NiCE hypotheses (H1–H4) that link liquidity shocks, scarcity mispricing, behavioral overshoot, and recursive financial engineering to measurable symbol–substrate drift, and test them across derivatives, HFT, crypto, carbon, and healthcare pricing using identified shocks, matched panels, and placebo/over-control checks—with explicit falsifiers (null effects, sign reversals, or attenuation to zero under robustness) determining failure."

By addressing the conceptual, methodological, and empirical challenges identified in previous critiques of our framework, we aim to provide a more robust, theoretically sound, and empirically grounded account of what it means to be human. Our goal is not to replace existing approaches but to integrate them into a more holistic vision that respects the complexity and multi-faceted nature of human existence.

2. Theoretical Positioning

Situating the Triadic Framework

Before elaborating on the three corners of our framework, it is essential to situate our approach within existing theoretical traditions. The triadic framework we propose does not emerge in a vacuum but builds upon and integrates several influential research programs. By explicitly acknowledging these intellectual foundations, we can better articulate both the points of alignment and the novel contributions of our approach.

2.1 4E Cognition: Beyond the Cartesian Mind

The "4E" approach to cognition—which views cognition as embodied, embedded, enactive, and extended—represents a significant departure from traditional Cartesian dualism (Clark, 2008); (Varela, Thompson& Rosch, 1991). This perspective aligns closely with our framework in several key respects:

Points of Alignment: Our characterization of humans as “embodied narrative agents” resonates strongly with embodied cognition’s insistence that cognitive processes are fundamentally shaped by the body’s sensorimotor capacities (Gallagher, 2005), with narrative psychology’s demonstration that individuals construct meaning and coherence through life stories (McAdams, 2001), and with the view that narrative itself is a primary means by which humans construct reality (Bruner, 1991). Similarly, our emphasis on the environment as a "**constitutive context**" parallels the embedded and extended views, which hold that cognition cannot be understood in isolation from the physical and social environments in which it occurs (Hutchins, 1995).

Novel Contributions: While 4E approaches have revolutionized our understanding of cognition, they have often focused primarily on the relationship between embodiment and environment, with less attention to the phenomenological dimensions of consciousness. Our triadic framework explicitly incorporates *consciousness as a co-equal partner*, emphasizing how **phenomenal experience** (Block, 1995); (Nagel, 1974), **access awareness**, and **reflective self-awareness** as characterized in higher-order thought theories (Rosenthal, 2005) interact with embodied capacities and environmental contexts (Chalmers, 1995).

Integration: We extend the 4E framework by emphasizing *the role of sensorimotor contingencies and participatory sense-making as specific mechanisms through which the environment configures capacities into conscious content* (De Jaegher, & Di Paolo, 2007). For example, the way cultural practices shape attention and perception is not merely an external influence but constitutes the very structure of conscious experience.

2.2 Niche Construction and Cultural Evolution

The theories of **niche construction** (Odling-Smee, Laland, & Feldman, 2003) and **cultural evolution** (Boyd & Richerson, 1985); (Richerson, & Boyd, 2005); (Tomasello, 1999) have transformed our understanding of human adaptation by highlighting *the bidirectional relationship between organisms and their environments*.

Points of Alignment. Our characterization of humans as "**creative adapters**" and our emphasis on the "**cultural-symbolic context**" align closely with these theories. We share the view that *humans do not merely adapt to pre-existing environments but actively modify those environments, creating niches that then exert selective pressures on subsequent generations* (Laland et al., 2000). Building on this, Tomasello (1999) demonstrates how uniquely *human cognition develops through culturally scaffolded practices of joint attention and shared intentionality*, providing a developmental pathway through which *symbolic systems and social norms become constitutive of human adaptation*. Deacon (1997) further underscores this point by showing how language and symbolic reference co-evolved with the human brain, making symbolic mediation itself a selective environment. Finally, Markus and Kitayama (1991) illustrate how cultural contexts stabilize distinct forms of selfhood (Markus & Kitayama, 1991) and, at the neural level, shape the functional organization of the brain itself (Park & Huang, 2010)—independent or interdependent—that shape cognition, emotion, and motivation, exemplifying how symbolic niches consolidate into enduring modes of consciousness.

Novel Contributions. While **niche construction theory** has primarily focused on the biological and ecological dimensions of this process, our framework *explicitly incorporates consciousness as a key mediator*. The capacity for reflective self-awareness and intentionality allows humans to consciously design and redesign their niches in ways that go beyond the capabilities of other species.

Integration. We extend these theories by emphasizing the *inter-directional feedback between nature, consciousness, and environment*: we engineer niches (*material, institutional, symbolic*) that selectively stabilize certain forms of consciousness and selfhood, which in turn influence the further development of those niches (Sterelny, 2012). Importantly, this recursive process *operates through* **neuroplastic mechanisms** *by which conscious experience and cultural practices reorganize neural circuits over time* (Askenasy & Lehmann, 2013). The result is a dynamic, co-evolutionary process that unfolds across multiple timescales—from the immediate effects of environmental changes on conscious experience, to the long-term evolutionary consequences of symbolic and cultural evolution.

2.3 Predictive Processing and Active Inference

The **predictive processing** framework (Clark, 2013) and its extension into **active inference** (Friston, 2010) represent a powerful computational approach to understanding perception, action, and cognition.

Points of Alignment: Our components of "access awareness" and "intentionality" can be naturally cast within this framework. **Access awareness** *corresponds to the process by which certain predictions become globally available for higher-level processing*, while **intentionality** *aligns with the goal-directed nature of active inference*, where organisms act to confirm their predictions about the world (Seth, 2014); uniquely, humans extend this capacity into **flexible mental time travel**, projecting past and future scenarios that scaffold planning and cultural transmission (Suddendorf & Corballis, 2007).

Novel Contributions: While predictive processing has primarily focused on the neural and computational mechanisms of perception and action, our framework explicitly connects these processes to both evolved capacities and environmental contexts. We emphasize *how cultural practices and symbolic systems shape the priors that guide prediction, while conscious* *reflection can modify these priors.* **Episodic memory** provides the substrate for this process, allowing humans not only to recall past experiences but also to simulate possible futures (Tulving, 2002), a capacity that aligns with predictive and active inference frameworks (Suddendorf & Corballis, 2007).

Integration: The mathematics of **variational free energy** and **expected free energy** offers a formal language for describing the "*capacity–context–experience*" loops central to our framework (Ramstead, Badcock, & Friston, 2018). Specifically, *nature provides the constraint priors*, the *environment shapes the likelihoods*, and *consciousness guides the selection of policies* (**planned action sequences**) *based on expected free energy minimization*. This formal approach allows us to move beyond metaphorical descriptions of the relationships between our three corners.

2.4 Developmental Systems Theory

Developmental Systems Theory (DST) (Oyama, Griffiths, & Gray, (Eds.), 2001) rejects simplistic nature-nurture dichotomies in favor of a more integrated view of development as emerging from the complex interactions between multiple resources.

Points of Alignment: Our emphasis on the "*developmental context*" and the *plasticity of human nature* aligns closely with DST's rejection of genetic determinism. We share the view that development is not the unfolding of a pre-specified program but *a dynamic process involving multiple interacting factors* (Gottlieb, 2007).

Novel Contributions: While DST has primarily focused on the developmental processes that lead to adult phenotypes, our framework explicitly incorporates consciousness as both *a product of these developmental processes* and *an active force in shaping them*. The emergence of reflective self-awareness, for example, transforms the developmental trajectory by *allowing for conscious self-modification*.

Integration: We adopt DST's "resources" language to concretize what we mean by **"constitutive" relationships** (Griffiths, & Gray, 1994). Genes, cells, bodies, caregivers, artifacts, and symbolic systems are all resources that *contribute to the development of both our capacities and our conscious faculties.* This helps clarify that when we speak of the environment as "constitutive," we are referring to *specific material and social resources that are necessary for the development and expression of human nature and consciousness*.

2.5 Semiotics and Peircean Triads

The **semiotic tradition**, particularly Charles Sanders Peirce's triadic model of *sign, object, and interpretant* (Peirce, 1931-1958), offers a powerful framework for understanding meaning-making processes.

Points of Alignment. Our triadic structure resonates with Peirce's model, suggesting a deep connection between the structure of meaning and the structure of human existence. Just as a sign requires an object and an interpretant to function, human existence requires the integration of nature, consciousness, and environment. This perspective is reinforced by Deacon's account of humans as a *symbolic species*, in which the co-evolution of language and the brain positioned symbolic reference as the central adaptive innovation that distinguishes our species (Deacon, 1997).

Novel Contributions. While semiotics has primarily focused on the structure of meaning in language and other symbolic systems, our framework extends this triadic approach to the fundamental structure of human existence itself. We suggest that *the capacity for* **meaning-making** *is not merely one human ability among many but is central to what makes us human* (Baumeister, 1991)—a claim that finds developmental and evolutionary support in the symbolic scaffolds emphasized by Deacon (1997).

Integration. We can map our triadic framework onto Peirce's model in illuminating ways: the environment functions as a sign-rich scaffold, nature provides the evolved interpretive constraints, and consciousness emerges as the dynamic process of interpretation (Deacon, 1997; Deacon, 2011). This mapping clarifies what we mean by "meaning-making" without reducing culture to psychology or treating meaning as something that exists independently of interpreters.

2.6 Synthesis: A Pluralistic Integration

Rather than aligning exclusively with any single theoretical tradition, our framework represents a **pluralistic integration** that draws on the strengths of each while addressing their limitations. We recognize that *different theoretical approaches may be more or less useful for understanding different aspects of the human condition*.

This pluralistic stance extends to our treatment of consciousness, where we acknowledge the contributions of **Integrated Information Theory (IIT)** (Tononi, Boly, Massimini, & Koch, 2016), **Global Neuronal Workspace (GNW)**Theory (Mashour, Roelfsema, Changeux, & Dehaene, 2020), and **Higher-Order Thought Theory (HOT)** (Lau, & Rosenthal 2011), without attempting to force them into a single unified theory. Instead, we suggest that *these theories may be addressing different aspects or levels of the complex phenomenon we call consciousness*.

By situating our framework within these broader theoretical traditions, we aim to build bridges between previously disconnected research programs and to provide a more comprehensive and nuanced understanding of what it means to be human. The triadic framework we propose is not intended to replace these existing approaches but to integrate them into a more holistic vision of the human condition.

2.7 Ontological Commitments and the Mind–Body Problem (NiCE)

2.7.1 Non-reductive physicalism via triadic constitution

We adopt a **non-reductive physicalist** stance that avoids both eliminativism and property dualism. All processes are physically realized, yet consciousness is not a separable "stuff"; it is an **organizational regime** arising from the mutual constitution of **organismic dynamics (N)**, **worldly scaffolds (E)**, and **recursive self-modeling (C)**. On this view, the familiar "**hard problem of consciousness**" (Chalmers, 1995) misfires when it first strips away constitutive organism–world relations and then demands a direct reduction of first-person phenomenology to residual third-person descriptors.

We call the positive alternative **experiential constitution**: predictive models, environmental affordances, and bodily constraints **co-determine** experiential content, yielding **system-level causal powers** not reducible to component parts. This framing clarifies how prominent theories interlock: **IIT** speaks to phenomenal structure generated by triadic co-integration; **GNW** to which modeled contents achieve global availability; **HOT** to metacognitive appraisal of those contents. The character of experience tracks specific N–C–E patterns (e.g., color as the upshot of wavelength-sensitive vision in situ, illumination and learned categories, nested in an evo-devo history of discrimination).

Methodological pluralism follows:

- **First-person** phenomenology to characterize lived structure.
- **Third-person** neuroscience to map mechanisms.
- **Second-person/interactional** methods to capture constitutive organism–world coupling.

2.7.2 Worked example: Perceiving a red stop sign at dusk

Scenario. A driver approaches an intersection at dusk and experiences a red stop sign, recognizes its meaning, and brakes.
Triadic constitution in one pass.

- **E:** spectral energy under dusk illumination, red pigment reflectance, sign geometry/typography, and the learned convention "red = stop."
- **N:** L/M cone responses → opponent coding → V1/V2/V4 color networks; ventral object/word-form circuits; fronto-parietal control; arousal; motor plans.
- **C:** phenomenal "redness," semantic access ("STOP"), metacognitive confidence, felt agency in braking.

Where theories interlock (non-redundant).

- **IIT (phenomenal structure):** integrated patterns across color/associative networks underwrite the *feel* of red.
- **GNW (access/broadcast):** the sign representation wins broadcast and enters working memory & policy selection.
- **HOT (metacognition):** higher-order appraisal yields graded confidence and reportability.

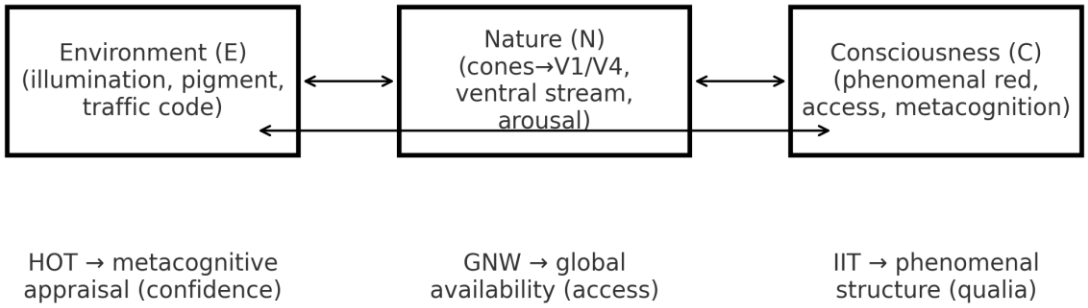


Figure 3 - Triadic constitution of perceiving a red stop sign at dusk

Depicts Environment (E), Nature (N), and Consciousness (C) as three coupled components of a single episode: a driver experiences a red stop sign at dusk and brakes. Bidirectional arrows indicate mutual constitution at the moment of perception: (E↔N) spectral illumination, pigment reflectance, sign geometry/typography, and the cultural rule "red = stop" shape and are shaped by retinal and cortical color pathways; (N↔C) visual and control circuits realize the phenomenal feel of red, semantic access ("STOP"), and metacognitive confidence; (E↔C) scene structure and social convention co-determine conscious meaning and action readiness.

Constitutive / causal / enabling.

At time *t*, E–N–C organization is **constitutive** of the experience; over $t \to t + \Delta$, exposures **cause** tuning of ventral stream and control policies; conventions and traffic systems are **enabling** preconditions that make the meaning of red available at all.

Empirical levers (predictions):

Manipulating **E** (illumination, symbol convention) should shift multivariate qualia patterns (IIT-adjacent), alter broadcast latency/probability (GNW), and modulate confidence calibration (HOT). Manipulating **N** (trichromats vs. dichromats; arousal via sleep/caffeine) should change qualia structure, broadcast thresholds, and confidence slopes. Manipulating **C** (metacognitive set; trial-wise confidence) should change metacognitive readouts that track broadcast strength and covary with qualia-pattern indices.

2.7.3 Responsibility without Stigma: From Victimhood to Collaborative Empowerment

Claim:

Consciousness (C) is **normatively neutral**; its value depends on how it is **organized** and **oriented**. When C is stabilized around a **victimhood self-model**—a durable appraisal of powerlessness and grievance—it can produce **negative cross-level returns** (constricted agency, stress loops, and incentives that reward grievance signals over problem-solving). When C acknowledges harm **and** pivots to **responsibility-bearing, collaborative action**, it tends to produce **positive cross-level returns**: bodies calm, environments change, and conscious appraisals widen.

Triadic principle (reciprocal fortification). In the N–C–E system, strengthening any pillar **fortifies the others**:

- **N → C/E.** Better sleep and autonomic regulation widen attentional bandwidth and reduce reactivity, making cooperation feasible.
- **C → N/E.** Shifting appraisals from grievance to **joint responsibility** increases exploration, goal pursuit, and adherence to pro-social norms.
- **E → N/C.** Rules, incentives, and institutions that reward repair (not spectacle) make calm bodies and responsible minds **easier** to sustain.

Natural constraint:

Life is continuous work against drift: organisms must exert effort to resist entropic and homeostatic decline. In that thin sense, **we are all vulnerable** to failure. The point is **not** to celebrate victimhood, but to **organize responsibility**—individually **and** collectively—to keep systems viable. Naming injury is the start of responsibility, not its negation.

Practical posture (what we recommend)

1. **Validate, then equip.** Name the harm (avoid gaslighting). Immediately pair recognition with concrete options for action (whose role, what step, when).
2. **Shift the narrative target.** From "I/we are harmed" to "We are the team that repairs this." Make **collaborative responsibility** the salient identity.
3. **Build capabilities.** Teach autonomic skills (breathing/HRV), conflict scripts, metacognitive checks, and basic civics of change (how to move an issue through process).
4. **Align incentives.** Create reporting channels that route to **co-designed fixes** with timelines, not just punitive endpoints. Publicly log solved problems.
5. **Measure agency, not outrage.** Track collective efficacy, time-to-solution, participation in repair, and reductions in repeat incidents.

Guardrails (to avoid stigma or denial)

- **Recognition before redirection.** Responsibility talk must **follow** credible validation and safety planning.
- **Collective, not blame-shifting.** "Responsibility" means **shared** work (students, staff, administration), not moralizing at the injured.

- **Equity.** Audit who gets heard and who benefits from restorative options; publish disaggregated outcomes.

Operationalization (brief)

- **N (physiology):** Offer short HRV-biofeedback and sleep hygiene; expect drops in anxiety and irritability and higher tolerance for disagreement.
- **C (appraisal/identity):** Use micro-modules (pre-bunking, meta-perception correction) and **responsibility framing** to reduce rumor cascades and hostile attributions.
- **E (context/incentives):** Stand up multidisciplinary threat-assessment and repair pathways; adopt no-notoriety communications; reward solution proposals and co-design participation.

Box: Language that preserves dignity *and* agency

- **Instead of:** "Victims must speak up."
  Use: "Those harmed are recognized and protected; we will work with you to design and implement the remedy – focus on systematic attention to a positive principled C N E plan and empirical evaluations."
- **Instead of:** "File a complaint."
  Use: "Report and **co-design** the fix; here are the steps and the decision points."
- **Instead of:** "Zero tolerance."
  Use: "Clear boundaries + clear remedies; here is the path to repair or separation."

Metrics (what success looks like)

- **Agency/Efficacy:** Collective-efficacy scales; proportion of reports that reach a co-designed solution.
- **Arousal/Stress:** GAD-7 change; HRV (for enrollees); nurse visits.
- **Climate/Conflict:** Time-to-resolution, repeat incidents, disciplinary referrals.
- **Narrative shift:** Text analysis of campus communications for increases in "we can / we will" vs. "they always / they never."

2.7.4 Reframing the Hard Problem (within NiCE)

The "hard problem" asks *why physical processes should give rise to subjective experience* (Chalmers, 1995). On the NiCE view, the puzzle partly arises from a category error: abstracting away the constitutive **E–N–C relations** (Environment–Nature–Consciousness) and then demanding a reduction from the remainder to phenomenology. We instead treat consciousness as a **triadic organizational regime** characterized by (i) recursive self-modeling, (ii) temporal integration, and (iii) embodied situatedness.

- **Neither dualism nor panpsychism**

Experience is not a second substance nor a universal property of matter; it is the *mode of organization* that emerges when a system models its own modeling while embedded in a richly structured world.

- **Bridge to extant theories**

  NiCE provides the constitutive story that Integrated Information Theory (IIT) measures reflect; explains which contents Global Neuronal Workspace (GNW) will broadcast; and clarifies why Higher-Order Thought (HOT) theories link metacognition to graded reportability.

- **Why the hard problem feels hard**

  "Head-only" or "world-only" approaches miss the relational nature of experience. Progress requires methodological pluralism and experiments that perturb **E, N, and C together**.

Empirical program (pointer).

Traditional research often seeks **Neural Correlates of Consciousness (NCCs)**—the minimal neural mechanisms sufficient for a particular conscious experience. While valuable, this approach risks isolating fragments rather than explaining the *constitutive dynamics* that generate experience. The NiCE framework suggests shifting focus toward how consciousness arises from the interplay of environment, body, and recursive modeling:

- **How environmental perturbations shape the contents of experience.**

  Altering sensory or social context (e.g., lighting, soundscapes, group presence) changes not only *what* is experienced but *how* it is structured. This shows that content is co-constituted by the system and its world, not reducible to neural activity alone.

- **How bodily states modulate the qualitative feel of experience.**

  Interoceptive signals—heartbeat, breath, hormonal rhythms—color the texture of experience. The same external event can feel safe or threatening depending on bodily state, underscoring that phenomenology is grounded in physiology.

- **What a recursive self-modeling yields presence and agency.**

  When a system models its own modeling, it generates the sense of "mineness" and authorship. This recursive loop explains why experience feels owned and why agency emerges as more than mere motor output.

(See §4.3.2 on measurement and §5 on the research program for operationalization.)

2.7.5 One experiment, three levers)

Table 1- Predictions, Measures, and Falsifiers

Lever	**Manipulation**	**Predictions and Measures**

Environmental (E)	Change illumination/spectrum; alter symbol convention (non-red stop cue)	IIT: multivariate qualia pattern shifts; GNW: ignition probability/latency changes; HOT: confidence calibration (meta-d′).
Biological (N)	Compare trichromats vs dichromats; modulate arousal (sleep/caffeine)	IIT: qualia & classification differences; GNW: broadcast thresholds; HOT: altered confidence slopes.
Cognitive/Recursive (C)	Require trial-wise confidence/error prediction; introspective set	HOT: enhanced metacognitive readouts tracking GNW strength; covariation with IIT-like multivariate signatures.

Falsifiers:

If illumination/cultural perturbations change behavior without GNW/HOT signatures, access/metacognition claims are too strong; if cone-level differences leave qualia reports unchanged, the IIT mapping is too loose; if confidence is unrelated to broadcast or performance, HOT's role is overclaimed.

2.7.6 Reciprocal Vulnerability and Testable Principles

Thesis. In a triadic system, **undermining any pillar (N, C, or E)** degrades the other two—sometimes immediately, sometimes with a lag. Conversely, **fortifying any pillar** tends to improve the others. Thus **C, E, and N are "testably bad when bad and good when good"**: their organization and orientation determine measurable cross-level effects. The aim is not to stigmatize suffering but to **transform it**—so that recognition of harm becomes a launching point for **shared responsibility** and **durable progress**.

Programmatic corollary. It follows that we must **identify and test the principles** within each pillar that reliably yield positive vs. negative outcomes, and use those findings to evaluate existing systems and design proactive, corrective ones.

Principles to test (illustrative, not exhaustive)

- **Nature (N) — physiological regulation**
  - *Positive:* sleep regularity; autonomic flexibility (HRV); stabilizing routines for energy and arousal.
  - *Negative:* chronic sleep restriction; sustained hyper-/hypo-arousal; intoxicant-driven volatility.

  - *Expected cross-effects:* Better N → wider attentional bandwidth (C) and less conflict/reactivity (E).

- **Consciousness (C) — appraisal, metacognition, identity**

  - *Positive:* responsibility framing (harm acknowledged → action options); calibrated confidence (meta-d′); narrative coherence without grievance fixation.

  - *Negative:* self-sealing grievance identities; certainty inflation; rumination loops.

  - *Expected cross-effects:* Better C → pro-social norms and solution uptake (E); calmer physiology (N).

- **Environment (E) — incentives, transparency, affordances**

  - *Positive:* clear repair pathways (report → co-design → timeline); incentives for solutions over spectacle; means-safety and de-escalation norms.

  - *Negative:* notoriety incentives; opaque processes; contagion-prone communications.

  - *Expected cross-effects:* Better E → reduced baseline arousal (N) and less hostile appraisal (C).

From slogans to science: hypotheses, measures, falsifiers

- **Hypotheses (examples).**

  1. Improving **N** (sleep/HRV) reduces disciplinary incidents and hostile attributions (**C**) and lowers rumor-sharing (**E**).

  2. Shifting **C** from grievance to responsibility increases policy engagement (**E**) and improves emotion regulation (**N**).

  3. Installing **E** repair pathways shortens time-to-resolution and lowers anxiety scores (**N**) while raising collective efficacy (**C**).

- **Measures.** Sleep duration; HRV; anxiety/irritability indices; meta-cognition (confidence calibration); collective-efficacy scales; time-to-resolution; incident and repeat-incident rates; rumor-sharing/virality metrics.

- **Falsifiers.** No change (or worsening) on pre-registered outcomes when a principle is implemented at adequate dose; improvements without predicted cross-level covariation; effects that vanish under stepped-wedge or cluster-randomized rollout.

- **Lags and asymmetries.** Expect **fast C and E shifts** (weeks) and **slower N changes** (months); analyze with time-lagged models to capture directionality.

Upshot. The framework is **action-guiding**: strengthen any pillar to nudge the others, and **audit principles** to keep what produces gains and discard what does not. In practice, this means pairing **recognition of harm** with **physiological support (N)**, **responsibility-bearing appraisals (C)**, and **institutions that reward repair (E)**—a recipe that is **rational, predictive, and testable**.

2.7.7 Incentive Architecture: Natural, Corrective, and Tunably Evaluated

Claim. Because **Nature (N)**, **Consciousness (C)**, and **Environment (E)** co-constitute behavior, **incentive systems** should be designed and audited triadically. By "natural incentivization," we mean structures that leverage ordinary human tendencies—**autonomy, competence, relatedness, fairness, and meaning**—so that prosocial choices are *parsimoniously effective, dignified, and worthwhile*. Corrective and, when legitimately viable, punitive instruments remain viable and available, but only within transparent guardrails and under continuous, bias-aware evaluation.

Design axioms (triadic)

1. **Align with bodies (N):** Reduce physiological costs of good behavior (sleep-compatible schedules; calm starts; friction for impulsive harms).
2. **Clarify value (C):** Make desired actions legible and self-reinforcing (confidence, efficacy, shared identity); pair recognition with **specific next steps**.
3. **Shape affordances (E):** Defaults, rules, and pathways should make repair easier than spectacle (single reporting link → co-design → timeline).
4. **Graduated response:** Use **restorative, capability-building** responses first; reserve sanctions for risk containment and repeated non-engagement.
5. **No perverse rewards:** Do not incentivize grievance displays or notoriety; reward **solutions, participation, and repair**.
6. **Tune by evidence:** Pre-register outcomes; run stepped-wedge/cluster rollouts; **audit equity**; publish privacy-preserving dashboards.

Worked examples (academic settings)

- **Reporting→Repair Credits (E↔C↔N).**
  Mechanism: Reports that progress to a **co-designed fix** earn "repair credits" (recognition, micro-grants, preferred room bookings).
  Triadic effect: Clear path (E) → agency and efficacy (C) → calmer classrooms (N).
  Metrics: time-to-resolution, repeat incidents, participation rates.
- **Epistemic Resilience Badges (C↔E).**
  Mechanism: Brief **prebunking** and **metaperception** modules earn transcript-visible badges; departments with high completion get micro-funding.
  Effect: Better calibration (C) → less rumor contagion (E).
  Metrics: misinformation susceptibility, rumor-sharing, support-for-violence scales.
- **Means-Safety Incentives (E→N,C).**
  Mechanism: Family safe-storage pledges with free lockboxes; housing points/parking priority for verified compliance (where appropriate).
  Effect: Safer environment (E) → lower arousal and risk (N) → reduced threat posture

(C).
Metrics: pledge rates, averted threats, incident severity.

- **Calm-Start Norms (N→C,E).**
  Mechanism: 60-second breathing routine at class start; optional quiet rooms before exams.
  Effect: Improved autonomic flexibility (N) → better attention and civility (C) → fewer disruptions (E).
  Metrics: HRV in enrollees, office referrals, nurse visits.

- **No-Notoriety Standard (E→C,N).**
  Mechanism: Campus comms avoid glamorizing perpetrators; emphasize resources and community repair.
  Effect: Fewer contagion incentives (E) → lower salience of harmful scripts (C) → reduced stress reactivity (N).
  Metrics: copycat indicators, threat mentions, sentiment analysis.

Corrective and punitive tools (with functionality guardrails)

- **Restorative first:** Structured dialog + commitments + follow-ups that are **rewarded when completed** (record expungement, access restoration).
- **Graduated sanctions:** Only when risk persists or repair is refused; **time-bound**, **appealable**, and paired with a **re-entry pathway**.
- **Emergency separation:** For credible imminent risk; coupled to after-action review and transparent criteria.
- **Guardrails:** Due process; disparate-impact audits; independent oversight; periodic "sunset" of measures unless renewed by data.

Honest, unbiased evaluation (tuning in practice)

- **Design:** Stepped-wedge or cluster randomization; holdout cohorts where feasible; pre-registered hypotheses and **falsifiers**.
- **Outcome families:**
  - *N:* sleep duration; HRV (program enrollees); nurse visits.
  - *C:* calibrated confidence (meta-indices), collective efficacy, hostility/anxiety scales.
  - *E:* time-to-resolution, repeat incidents, rumor-sharing/virality, averted-vs-completed threat ratio.
- **Fairness & bias checks:** Disaggregate by subgroup; blind outcome adjudication where possible; publish audit summaries.
- **Perverse-incentive sentinels:** Metric gaming, grievance inflation, chilling effects on speech, disproportionate impact—trigger **stop-loss rules** and redesign.

Why it works (reciprocal returns)

- **N→C/E:** Lower physiological load makes prosocial choices easier to *feel* and *enact*.
- **C→N/E:** Responsibility-bearing appraisals widen choice sets and reduce hostility.
- **E→N/C:** Affordances and rules that reward repair make calm bodies and responsible minds **sustainable**.
  Undermining any pillar degrades the others; **fortifying any pillar** tends to lift all three. Incentives are the *knobs* we can turn—**rationally and predictively**—to shift the whole system toward **durable progress**.

2.7.8 Implementation in Adversarial Systems: Incentive-Compatible Governance

Problem. Empirical knowledge does not self-execute. Reforms fail when Environment (E) rewards spectacle over repair, when Consciousness (C)—individual and institutional—yields to bias, motivated reasoning, or narrative capture, and when Nature (N) is overloaded by stress, fatigue, or fear. To move from *knowing* to *doing*, incentive and safeguard architectures must keep N–C–E aligned even in adversarial conditions, including systemic foreign and domestic sophistry (disinformation, agitation-propaganda, and strategic rumor).

Principle. Implementation must be **incentive-compatible**: the *easiest* path for actors—political, bureaucratic, commercial—is the one that advances the empirically validated goal. Where interests diverge, we install **credible commitments** and **independent checks**.

Triadic Implementation Protocol (TIP)

- **N (Capacity & Load):** Protect decision quality. Build routines (sleep-compatible schedules for key decisions, HRV/breath regulation in high-strain roles, decision checklists) that lower cognitive load and bias.
- **C (Transparency & Norms):** Make the value of truth-seeking salient and **trackable**: pre-commit to evaluation, disclose conflicts, and normalize correction over face-saving.
- **E (Rules & Affordances):** Set structures so repair is easier than theater: open pipelines from problem reports to co-designed fixes, and automatic feedback to stakeholders.

Mechanisms (concrete, deployable)

Independent evidence & anti-capture

- **Policy preregistration & public registries** for major initiatives (outcomes, timelines, falsifiers).
- **Firewall between implementers and evaluators** (internal evaluation unit with statutory independence, or third-party auditors).

- **Randomized audits** and **stepped-wedge rollouts** to identify what actually works; rotate audit targets to deter gaming.
- **Red-team reviews** and **algorithmic impact assessments** for high-risk policies and platforms.

Incentive alignment

- **Pay-for-outcomes contracts** with claw-backs when targets aren't met (guardrails to prevent cream-skimming).
- **Milestone or social-impact bonds** where payout depends on verified outcomes, not process metrics.
- **Repair credits** (recognition, micro-grants, access privileges) for teams that move issues from report → fix on time.
- **No-notoriety standards** and platform **frictions** during designated "risk windows" to reduce contagion incentives.

Integrity & safety

- **Whistleblower protections and bounties** (clearly scoped; independent ombuds).
- **Conflict-of-interest registries** and **cooling-off rules** (procurement/revolving door).
- **Open spending & outcome dashboards** (privacy-preserving) so the public can audit progress.

Participation that produces

- **Participatory budgeting/mini-publics** tied to the evidence registry: citizens allocate a portion of funds to **pre-vetted**, high-evidence pilots.
- **Co-design labs** (students/staff/community) with constrained menus (evidence-based options) and guaranteed decision timelines.

Operationalization & Measurement (from slogans to science)

- **Design:** Cluster randomization or stepped-wedge across schools/departments; *a priori* power and falsifiers.
- **Primary outcomes:** time-to-resolution for reported problems; repeat-incident rates; absenteeism/tardies; anxiety/hostility indices; averted-vs-completed threat ratio; rumor-sharing/virality metrics.
- **Process integrity:** % of initiatives preregistered; audit hit rate; conflict-of-interest disclosures; whistleblower case throughput.
- **Equity & rights:** disparate-impact audits; due-process timeliness; non-retaliation tracking; opt-outs for physiology modules.

- **Perverse-incentive sentinels:** metric gaming, chilling effects on speech, grievance inflation—triggers **stop-loss rules** and redesign.

Falsifiers (kill-switches).
If preregistered initiatives **do not** improve outcomes vs. controls, or if transparency/audits **do not** reduce misconduct, or if perverse incentives **increase** inequity or chilling effects, the mechanism fails; it must be revised or removed. TIP is a **theory of practice**, not an article of faith.

Why the triad matters here

- **N→C/E:** Decision hygiene and load management improve judgment and reduce capture by fatigue or fear.
- **C→N/E:** Norms of preregistration and correction reduce ego costs for updating, making honest evaluation sustainable.
- **E→N/C:** Structures that reward verified repair—and penalize theatrics—make it *easier* for sane minds and steady bodies to prevail.

Upshot. The difficulty is not only epistemic ("what works") but **political-economic** ("who benefits"), **cognitive** ("how we decide under load"), and **institutional** ("what gets rewarded"). A triadic, incentive-compatible stack makes progress **implementable**: it converts empirical knowledge into **credible commitments**, aligns self-interest with public interest, and keeps the system honest through independent checks. That is how the framework survives contact with the real world—and how it delivers durable gains rather than one-off wins.

2.8 Tension, Stress, and Natural Incentive: Complementary Dynamics in the Human Paradigm

Conceptual Framing

Within the Human Paradigm, human adaptive capacity is shaped by three interrelated motivational dynamics: **tension, stress, and natural incentive**. Each operates at the intersection of nature, consciousness, and environment, but they differ in valence, role, and trajectory. Understanding their distinctions and complementarities clarifies how systems can sustain adaptive learning and avoid collapse.

2.8.1 Tension: Informational Gap Signals

- **Definition:** Tension refers to the *structured discrepancy* between current state and desired or target state.
- **Function:** Serves as an informational signal that highlights solvable gaps and orients systems toward reconfiguration.

- **Triad Mapping:**
    - *Nature*: error signals and adaptive gain mechanisms.
    - *Consciousness*: metacognitive awareness of gaps.
    - *Environment*: structured challenges and shared metrics.
- **Example:** A classroom assignment that reveals a knowledge gap while providing tools for resolution.

2.8.2 Stress: Energetic and Neuromodulatory Load

- **Definition:** Stress is the *cost profile* of responding to tension when demands exceed available capacity or persist without resolution.
- **Function:** Governs the physiological and cognitive strain of adaptation, with an inverted-U relation to performance.
- **Triad Mapping:**
    - *Nature*: arousal and neuromodulatory load (e.g., locus coeruleus activity, metabolic expenditure).
    - *Consciousness*: narrowed awareness, degraded calibration under overload.
    - *Environment*: punitive norms or low mobility amplify stress.
- **Example:** High-stakes testing environments where tension is poorly scaffolded, resulting in anxiety and performance collapse.

2.8.3 Natural Incentive: Intrinsic Motivational Attractors

- **Definition:** Natural incentives are *endogenous drives* (curiosity, mastery, belonging, autonomy) that make engagement rewarding in itself.
- **Function:** Anchor sustainable motivation and convert tension into growth rather than strain.
- **Triad Mapping:**
    - *Nature*: evolved reward circuitry (novelty, competence, sociality).
    - *Consciousness*: intrinsic satisfaction in meaning-making and progress.
    - *Environment*: designs that honor autonomy, belonging, and mastery.
- **Example:** Networked improvement communities where peer recognition and curiosity make collaborative problem-solving self-reinforcing.

2.8.4 Comparative Dynamics

- **Tension vs. Stress:** Two sides of a coin—tension is the gap signal; stress is the energetic cost of meeting it. Productive systems maximize tension while containing stress within recoverable bounds.
- **Tension vs. Natural Incentive:** Distinct motivational levers—tension orients toward what is missing; natural incentive sustains pursuit by making the process rewarding. Effective interventions combine both.
- **Stress vs. Natural Incentive:** Natural incentive buffers against chronic stress, converting arousal into flow. Without incentive, tension devolves into toxic stress.

2.8.5 Integrative Implications

1. **Design Principle:** Pair tension with natural incentive to foster productive challenge.
2. **Boundary Principle:** Respect plasticity limits by monitoring when stress overwhelms capacity.
3. **Contextual Principle:** Environments should scaffold tension (structured challenges), regulate stress (supportive norms), and amplify natural incentive (curiosity, belonging, mastery).
4. **Empirical Prediction:** Mixed-lever interventions (gap + incentive) outperform single-lever designs, especially across diverse contexts.

2.9 Tension, Stress, and Natural Incentive as Inherent Human Forces

2.9.1 Tension

Significance:
Tension is a *fundamental human constant*: the awareness of gaps between current and desired states. As Kitcey (2024) argued, humans are "beings of dynamic tensions," always pulled between autonomy and sociality, certainty and adaptability, rationality and emotion. These contradictions are not flaws but integral to human cognition and culture.

Rationale:
Tension signals "what is missing." Neurobiologically, it corresponds to error-detection and adaptive-gain processes. Psychologically, it manifests as curiosity, puzzlement, or discomfort. Socially, it arises in structured roles and expectations.

System Design Implication:
Designs should create *productive tension*: challenges calibrated to learners' or workers' current capacity. In classrooms, this means scaffolded tasks that reveal gaps without

overwhelming. In organizations, it means setting ambitious but attainable goals. Productive tension keeps systems adaptive, innovative, and forward-moving.

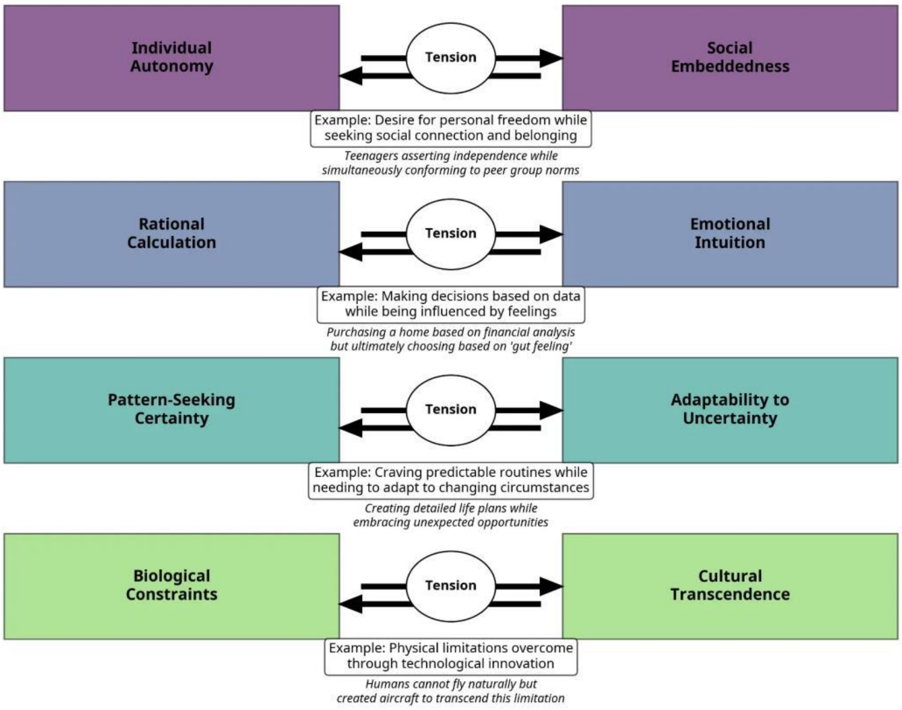
From Giddens to Kitcey – Paradoxes, Essence, and Paradigm

This box situates Kitcey's use of paradox and tension in relation to Anthony Giddens' (1991) classic sociological analysis. Giddens described modern identity as reflexively negotiated within paradoxes: autonomy vs. social embeddedness, rationality vs. emotion, certainty vs. uncertainty, and embodiment vs. transcendence. Kitcey (2024) extends this by framing such paradoxes not merely as sociological features of modernity but as ontological constants of human essence. The figure of 'Fundamental Paradoxes of Human Nature' illustrates this shift: tension is diagrammed as the integral node binding human contradictions, suggesting that paradox is not contingent but constitutive.

Kitcey (2025) further evolves this insight. In The Human Paradigm, reinterpreting tension as a functional signal within a triadic motivational ecology, interacting with stress (energetic load) and natural incentive (intrinsic attractors). The earlier paradoxes become design levers: gaps can be scaffolded into growth rather than collapse, provided they are paired with intrinsic incentive and supportive environments. Thus, what begins as sociological paradox in Giddens evolves through ontological essence, and ultimately a pragmatic design principle here in The Human Paradigm.

*Sources: Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age. * Stanford University Press.*

Fundamental Paradoxes of Human Nature



Based on Giddens, A. (1991). Modernity and self-identity: Self and society in the late modern age. Stanford University Press.

Figure 4 - Fundamental Paradoxes of Human Nature

Fundamental Paradoxes of Human Nature: Visual representation of the four paradoxes that characterize human existence—individual autonomy versus social embeddedness, rational calculation versus emotional intuition, pattern-seeking certainty versus adaptability to uncertainty, and biological constraints versus cultural transcendence. The central node of 'tension' highlights that these paradoxes are not anomalies to be resolved but integral contradictions that constitute the human condition.

Source: Adapted and evolved from Giddens (1991), *Modernity and self-identity: Self and society in the late modern age. * Stanford University Press.

Where Giddens (1991) described modern identity as reflexively organized within paradox, and Kitcey elevated such paradoxes to ontological constants of human essence and reframes tension as a design variable within a motivational ecology. The figure becomes applicable as the conceptual lineage from sociological paradox through human essence to system design.

2.9.2 Stress

Significance:
Stress is the *energetic and physiological cost* of responding to tension. It is a universal human

force: arousal that mobilizes resources for action. Moderate stress improves performance (the inverted-U principle), while chronic or excessive stress degrades it.

Rationale:
Stress is rooted in neuromodulatory systems (e.g., locus coeruleus, cortisol release). It is not simply "bad"; it is a mechanism for prioritization. However, unresolved or poorly scaffolded tension converts into toxic stress, exhausting capacity.

System Design Implication:
System designers must respect **plasticity bounds** and **energy budgets**. Educational, organizational, and policy systems should monitor stress loads, provide recovery cycles, and cultivate norms of psychological safety. High performance is not about eliminating stress but about balancing it within recoverable limits.

Illustrative examples at different scales, showing how unresolved or poorly scaffolded tension → toxic stress → exhausted capacity:

1. Education (Micro-level)

- **Scenario:** A student faces a math curriculum designed two grade levels above their current mastery, without scaffolding or feedback.
- **Tension:** They recognize the gap (they can't solve the problems).
- **Failure of scaffolding:** No stepwise support, no feedback loops, no peer mentoring.
- **Stress outcome:** Anxiety rises, sleep suffers, disengagement follows. Instead of fueling learning, the gap becomes toxic, undermining both confidence and capacity.

---

2. Workplace (Meso-level)

- **Scenario:** An early-career nurse is asked to manage a full ward on understaffed shifts.
- **Tension:** They know patient safety requires more capacity than they currently possess.
- **Failure of scaffolding:** No mentoring, no redistribution of caseloads, punitive culture discourages asking for help.
- **Stress outcome:** Emotional exhaustion, decision fatigue, eventual burnout. Here, systemic under-support converts necessary professional challenge into destructive overload.

---

3. Organizational Change (Meso/Macro)

- **Scenario:** A company launches a digital transformation, requiring all staff to adopt new software in two weeks.
- **Tension:** Employees recognize the skills gap.

- **Failure of scaffolding:** No training resources, no phased rollout, no help desk support.
- **Stress outcome:** Errors multiply, morale collapses, resistance hardens. A potentially adaptive tension (learning a new tool) becomes toxic stress (fear of failure, exhaustion, turnover).

---

4. Policy / Society (Macro-level)

- **Scenario:** Citizens are told to adapt to sweeping climate policies (e.g., sudden fuel bans) without accessible alternatives.
- **Tension:** They grasp the discrepancy between required lifestyle change and current options.
- **Failure of scaffolding:** No subsidies, no viable transportation infrastructure, no phased transitions.
- **Stress outcome:** Public frustration, distrust, protest movements. Collective adaptive capacity is drained, and compliance falters.

2.9.3 Natural Incentive

Significance:
Natural incentive is the *positive pole* of human motivation: intrinsic drives such as curiosity, mastery, belonging, fairness, and autonomy. It is what makes humans engage willingly, not just under pressure. We highlight natural incentive as the key to making tension productive instead of stressful.

Rationale:
These incentives evolved because they promoted survival and cooperation. They are anchored in reward circuitry and cultural meaning-making. When aligned with system goals, they make sustained learning and collaboration feel rewarding in themselves.

System Design Implication:
Effective systems harness natural incentives by making activities meaningful, autonomous, and socially connected. In education, inquiry-driven learning engages curiosity. In organizations, peer networks and recognition activate belonging. In governance, lightweight scaffolds allow local autonomy while reinforcing competence and fairness. Systems that align with natural incentives are resilient and self-renewing.

Illustrative Examples:

- **Education:** Montessori and inquiry-based classrooms structure learning around children's natural curiosity rather than rote compliance. Students pursue questions that matter to them, which keeps motivation high and allows learning to renew itself across developmental stages.

- **Organizations:** Networked Improvement Communities (NICs) in education reform (Bryk et al., 2011; Feygin, 2020) harness professionals' intrinsic drive for mastery and belonging. By working collaboratively on shared problems of practice, improvement becomes a self-reinforcing cycle rather than a top-down mandate.

- **Governance:** Rwanda's performance contract system (Imihigo) pairs national goals with local autonomy, allowing communities to set targets aligned with their sense of fairness and competence. This structure sustains compliance and innovation because communities see themselves as co-authors of progress.

- **Science & Knowledge:** The open-source software movement and Wikipedia thrive not on extrinsic reward but on contributors' natural incentives—curiosity, recognition by peers, and the satisfaction of building something useful together. These communities continuously renew themselves because their motivation is self-generated.

2.9.4 Comparative Dynamics

- **Tension** provides *direction*: "Here is the gap."

- **Stress** defines *limits*: "Here is the cost."

- **Natural incentive** fuels *sustainability*: "Here is why it is worth it."

Together, they constitute a **motivational ecology** inherent to human nature. Designing with only one force (e.g., tension alone) leads to brittle systems. Balancing all three yields environments where humans are challenged, supported, and meaningfully engaged.

2.9.5 Summary

Tension, **stress**, and **natural incentive** are not synonymous but human—inherent **interdependent motivational forces**. Tension provides the informational spark, stress delineates energetic limits, and natural incentive supplies sustainable drive. Together, they constitute the motivational ecology at the heart of the Human Paradigm—explaining both the fragility and resilience of human systems.

2.10 Polycentric Scaling: Cell-First, Networked, Scaffolded

Claim. For complex social change, the elegant and pragmatic path is **cell-first** implementation (classrooms, departments, schools), networked diffusion (peer learning, shared metrics), and **lightweight national scaffolds** (minimum standards, registries, outcome-tied funding). This *balances local fit with country-level learning* (Durlak et al., 2011; Carr-Hill & Peart, 2020; Bryk et al., 2011; Feygin, 2020; Greenhalgh et al., 2004).

Why this works (N–C–E).

- **E (context): Small venues** *supply the clustered ties needed for norm adoption and coordinated repair* (Bryk et al., 2011; Feygin, 2020), while *national scaffolds align* *incentives and transparency* (Education Endowment Foundation, 2018; Cabinet Office, 2013).

- **C (mind): Local co-design** *increases ownership and metacognitive calibration* (Durlak et al., 2011), and **networked exemplars** *reduce motivated reasoning* by demonstrating that "people like us made this work" (Bryk et al., 2011; Greenhalgh et al., 2004).
- **N (physiology):** Cells can *pace change to human capacity* (e.g., sleep-compatible schedules, low-load routines), improving compliance and durability (Carr-Hill & Peart, 2020).

Decision rubric.

- **High heterogeneity?** Start cell-first, adapt, re-test (scaling-out) (Greenhalgh et al., 2004).
- **Strong externalities/contagion risk?** Add national guardrails (e.g., no-notoriety/frictions) while cells implement (Cabinet Office, 2013).
- **Biology-anchored generalizability (e.g., sleep)?** Use national minimums with local logistics (Carr-Hill & Peart, 2020).
- **Need to learn while scaling?** Employ stepped-wedge/cluster rollouts with preregistration and shared dashboards (Education Endowment Foundation, 2018; Roland & Guthrie, 2016).

Evaluation. Use RE-AIM for adoption, fidelity, and maintenance; preregister primary outcomes such as time-to-resolution, repeat incidents, rumor virality, and levels of anxiety or hostility; include fairness audits; and define kill-switches for perverse incentives (Education Endowment Foundation, 2018; Roland & Guthrie, 2016).

Upshot. Go small, tuned, and measurable—then diffuse through networks under light national scaffolds. This maximizes signal-to-noise, preserves local dignity, and still delivers predictable, auditable gains at scale (Leaver et al., 2022; Roland & Guthrie, 2016; Chalmers, 2000).

***Research Agenda**: Proposed Preregistered 2×2 Intervention Trials*

As an independent, self-funded researcher, I am unable to conduct large-scale trials myself. Instead, I provide here a set of proposed research designs intended as blueprints for others with institutional resources. These trials would allow rigorous testing of the Human Paradigm's predictions.

*1. **Consciousness** × Environment Interventions: A 2×2 factorial trial with two levers:*
- Consciousness lever (e.g., metacognitive prompts, reflective journaling: present vs. absent)
*- **Environment lever** (e.g., redesigned affordances, structured tools: present vs. absent)*
This design produces four groups (control, each lever alone, both levers combined) and tests both main effects and interactions. The critical prediction is synergy: combined interventions outperform either alone.

*2. **Developmental Specificity**: The same 2×2 structure applied across age cohorts (e.g., adolescents vs. adults), testing whether sensitive periods amplify intervention effects.*

*3. **Symbolic Mediation**: A 2×2 design introducing new representational tools (e.g., notation systems, AI copilots) crossed with reflective practice, to test how symbolic resources reshape conscious task structures.*

*4. **Plasticity Bounds**: A 2×2 design varying intervention intensity × metabolic/energy load to estimate ceilings of cognitive and neural change.*

These designs should be preregistered to ensure transparency and to clearly separate confirmatory from exploratory analyses. By articulating them here, the aim is to enable collaborators, institutions, and future investigators to test, refine, and extend this framework in a transparent, rigorous manner.

2.11 Tempo of Change, NiCE Short-Circuiting, and the Search for a Sweet Zone

The NiCE framework highlights the interplay of Nature (N), Consciousness (C), and Environment (E) in human adaptation. Yet both **sudden shocks** and **gradual drifts** can paradoxically short-circuit these adaptive mechanics. Sudden change overwhelms physiology and consciousness, while gradual change bypasses salience, leading to complacency and malaise.

This section synthesizes empirical evidence across climate science, public health, inequality, and technology to argue for a **"Goldilocks zone" of change tempo** — a rational pacing that is noticeable enough to motivate action yet absorbable within human plasticity limits.

2.11.1 Sudden Change: Overload as Catalyst

Mechanism: Sudden shocks (e.g., natural disasters, acute trauma, abrupt technological disruption) overwhelm N with stress hormones, narrow C into crisis mode, and reframe E as hostile.

Paradox: While destabilizing, shocks often catalyze urgent mitigation.

Examples:

Climate: Sudden cold snaps or heatwaves cause immediate mortality but also trigger rapid policy responses, e.g., European heatwave of 2003; (Robine et al., 2008).

Public health: Acute epidemics (e.g., SARS, COVID-19 onset) overwhelm systems but provoke unprecedented mobilization (Kickbusch et al., 2020).

Technology: Sudden automation shocks, e.g., U.S. manufacturing decline in the 1980s displaced workers but spurred retraining programs (Autor et al., 2003).

2.11.2 Gradual Change Biases:

Drift into Complacency

Mechanism: Incremental shifts evade detection. N adapts physiologically, C habituates, and E is perceived as stable even as it erodes.

Paradox: Tolerable in the short term, but insidious in the long term.

Examples:

Climate: Global mean surface temperature has risen ~1.1°C since pre-industrial times (IPCC, 2021). The incremental pace fosters normalization, delaying mitigation.

> The incremental pace of warming allows N to physiologically adjust to seasonal variability, while C normalizes the trend as background noise. E is perceived as stable until thresholds are crossed, delaying collective mitigation.

Systemic racism: Gradual Decline Paradox: Persistent wage and housing disparities erode opportunity slowly, tolerated until crises erupt (Rugh & Massey, 2010).

> Gradual inequities become embedded in E as "normal," with C habituating to disparities and N adapting to chronic stress loads. The slow erosion of opportunity suppresses urgency until acute crises force recognition.

Public health: Nutritional decline ("hidden hunger") and chronic stress accumulate silently, producing long-term pathology (Popkin et al., 2020; McEwen, 2004).

> Subclinical deficiencies and stress responses are absorbed by N over time, while C fails to register immediate salience. E appears unchanged, but cumulative drift produces systemic health burdens that surface only decades later.

Technology: Job precarity increases gradually with digitalization, normalized until industries collapse (Brynjolfsson & McAfee, 2014).

> Incremental erosion of stable employment is tolerated as C habituates to "flexibility" narratives. N absorbs stress through coping mechanisms, and E reorganizes around precarious labor until collapse reveals the fragility of the system.

Progress into Underappreciation

Mechanism: Incremental advances accumulate over time. N adapts smoothly, C habituates to improvements, and E is perceived as largely unchanged even as it transforms.

Paradox: Transformative in the long term, but paradoxically underappreciated in the short term.

Examples:

Climate: Expansion of renewable energy capacity has accelerated steadily over the past two decades (IEA, 2023).

> The gradual pace of decarbonization fosters the illusion of continuity, obscuring the scale of transformation. Incremental gains in solar, wind, and storage are absorbed by N as routine infrastructure, while C normalizes the shift as background progress. E appears stable, preserving the illusion of fossil-fuel dependence even as energy systems are restructured.

Systemic racism: Gradual Progress Paradox: Civil rights reforms, affirmative action, and anti-discrimination laws have produced measurable gains in access to education, housing, and employment over the past half-century (Chetty et al., 2020).

The perception that "things have remained the same" allows toxic stress to persist across generations, even as conditions measurably improve. Logical consequences include:

- **Minimization of lived progress.** Gains in education, housing, or opportunity are discounted because C habituates to each new baseline. Communities feel that "nothing has changed," which sustains the stress of futility despite measurable improvements.
- **Persistence of stereotypes that obscure recognition of change.** Because structural improvements are invisible to C, outdated stereotypes remain unchallenged. This reinforces the belief that disparities are static, even when data show otherwise.
- **Erosion of urgency for continued reform.** If progress is unseen, reform is perceived as ineffective. This breeds cynicism ("nothing works"), which undermines momentum for further change, even though reforms have in fact delivered gains.
- **Retention of chronic stress burdens despite measurable gains.** N continues to bear the physiological load of vigilance and discrimination because the perception of "no change" sustains hostile interpretive frames. The stress response does not recalibrate to reflect actual improvements in E.

Feminist progress: Expansions in women's rights, education, and workforce participation have reshaped opportunity structures over the past century (Heckman, 2006).

Yet the incremental pace sustains the perception of stasis. C habituates to each new gain as "normal," N adapts to shifting roles without acute stress, and E appears unchanged in its broad contours. The underappreciation of progress fosters unfair stereotypes (e.g., toxic masculinity, "special treatment" narratives), undermines male agency, perpetuates the illusion that equality is already achieved, and fuels backlash cycles that destabilize further reform. Unwarranted toxic stress (E) sustained for all cohorts spawning unwarranted social pathologies.

Public health: Global life expectancy has risen by more than 20 years since 1950 (Roser, Ortiz-Ospina, & Ritchie, 2013–2024).

The gradual pace of improvement paradoxically diminishes its salience. N adapts to longer lifespans as baseline, C normalizes survival gains as expected, and E appears unchanged in its institutions. The result is underappreciation of public health achievements, leaving systems vulnerable to complacency and funding erosion.

Technology: The steady diffusion of digital tools has dramatically expanded access to knowledge and communication (Brynjolfsson & McAfee, 2014).

Yet the incremental rollout sustains the illusion of continuity. N adapts to new cognitive and social affordances, C habituates to each innovation as routine, and E appears structurally stable. The underappreciation of progress obscures the scale of transformation, delaying governance reforms and reinforcing the myth of a static "status quo."

Table 2 - Dual Faces of Gradual Change in the NiCE Framework

Dimension	Gradual Decline Paradox (Drift into Complacency)	Gradual Progress Paradox (Underappreciation)
Mechanism	Incremental erosion evades detection; N adapts physiologically, C habituates, and E appears stable even as it degrades.	Incremental gains are absorbed smoothly; N adapts without strain, C habituates to improvements, and E appears unchanged even as it transforms.
Paradox	Tolerable in the short term, but insidious in the long term.	Transformative in the long term, but paradoxically underappreciated in the short term.
Climate	Global warming (~1.1°C rise) normalized, delaying mitigation (IPCC, 2021).	Renewable energy expansion normalized, obscuring scale of decarbonization (IEA, 2023).
Inequality / Social Systems	Systemic racism: persistent wage and housing disparities	Feminist progress: gradual gains in rights and participation underappreciated,

Dimension	Gradual Decline Paradox (Drift into Complacency)	Gradual Progress Paradox (Underappreciation)
	tolerated until crises erupt (Rugh & Massey, 2010).	sustaining stereotypes, undermining male agency, and fueling backlash cycles.
Public Health	Hidden hunger and chronic stress accumulate silently, producing long-term pathology (Popkin et al., 2020; McEwen, 2004).	Global life expectancy rises >20 years since 1950, yet normalized, leading to complacency and funding erosion (Roser, Ortiz-Ospina, & Ritchie, 2013–2024).
Technology	Job precarity increases gradually with digitalization, normalized until industries collapse (Brynjolfsson & McAfee, 2014).	Steady diffusion of digital tools expands access, but normalized as routine, delaying governance reforms (Brynjolfsson & McAfee, 2014).
NiCE Short Circuit	**C** habituates to decline, losing salience and urgency; **N** absorbs stress until thresholds break; **E** appears stable until collapse.	**C** habituates to progress, dulling recognition of transformation; **N** adapts seamlessly; **E** appears static, preserving the illusion of status quo. Unwarranted stress perpetuates

2.11.3 The Overload Paradox

Too-fast change destabilizes but incentivizes mitigation.

Rapid shocks overwhelm physiology (N) and narrow consciousness (C) into survival mode, destabilizing systems. Yet the very intensity of disruption makes scarcity and risk salient, often triggering urgent collective responses that would not occur under slower pressures.

Drift paradox: Too-slow change feels tolerable but suppresses intervention. Additionally, it underappreciates even significant progress with the result being the weight of toxic stress induced from the original condition of tension imbalance belligerently persisting out of sync with social gains

Incremental shifts allow N to adapt and C to habituate, creating the illusion of stability in E. Because the stress signal never crosses the salience threshold, problems accumulate silently, reducing motivation for timely corrective action.

Shared short-circuit: In both cases, NiCE correlations are disrupted:

Sudden: C is hijacked into reflex, losing integrative capacity.
Consciousness (C) is hijacked into reflexive responses, losing its integrative capacity to coordinate with N and E.

Gradual: C habituates, losing salience and urgency.
Consciousness (C) habituates to slow erosion, dulling salience and urgency, and thus failing to mobilize adaptive alignment with N and E.

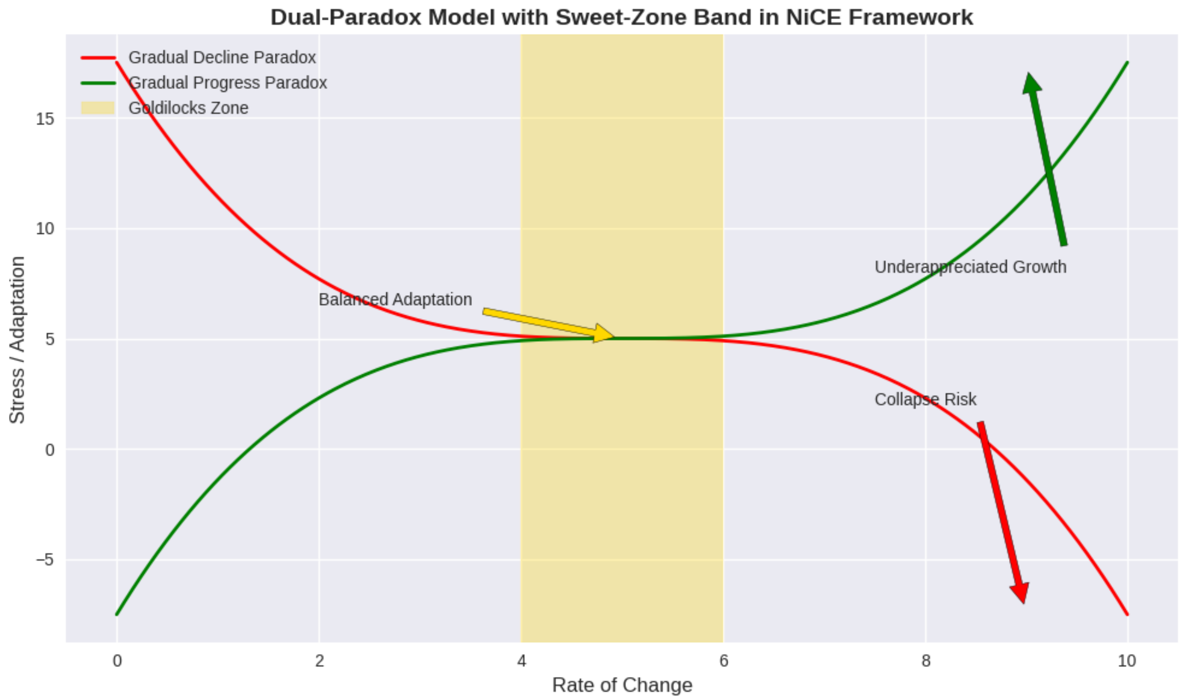


Figure 5 - Dual-Paradox Model with Sweet-Zone Band in the NiCE Framework.

The figure illustrates the relationship between rate of change (x-axis) and stress/adaptation (y-axis), highlighting two paradoxical trajectories and an optimal "Goldilocks" band. The Gradual Decline Paradox (red curve) shows how excessive rates of change overwhelm adaptive capacity, leading to collapse risk. The Gradual Progress Paradox (green curve) depicts how moderate acceleration can enhance adaptation, though its benefits are often underappreciated. The central Sweet-Zone Band (yellow) represents the balanced tempo in which environmental perturbations, bodily constraints, and predictive models remain in synchrony, yielding sustained adaptation with minimized stress. Arrows indicate the contrasting outcomes of collapse, underappreciated growth, and balanced adaptation.

2.11.4 Toward a Rational Sweet Zone

The challenge is to scaffold change within human plasticity (N) limits — fast enough to be noticed, slow enough to be absorbed.

Goldilocks pacing:

Climate: Phased adaptation (e.g., renewable energy milestones) sustains salience without collapse (IEA, 2023).

Incremental but visible milestones (e.g., renewable capacity targets) keep climate risks salient to C while allowing N and E to adjust gradually, avoiding both complacency and systemic overload.

Inequality: Targeted, visible reforms (e.g., early childhood interventions) produce generational gains without backlash (Heckman, 2006).

> Early, well-defined interventions yield measurable improvements that maintain public and political salience, while their gradual, generational pacing prevents social resistance or destabilization.

Public health: Campaigns with milestones (e.g., polio eradication drives) balance gradual improvement with perceptible impact (Roser, Ortiz-Ospina, & Ritchie, 2013–2024).

> Structured campaigns with clear benchmarks sustain both motivation in C and trust in E, while giving N time to adapt through improved immunity and health infrastructure, preventing drift into normalization of disease.

Technology: Phased retraining programs allow adaptation without collapse (Arntz et al., 2016).

> Gradual skill-building buffers workers (N) against stress, keeps technological disruption salient to C, and enables E (labor markets, institutions) to reorganize without triggering collapse.

2.11.5 Implications for Systems Engineering

Design principle: Tune change to fall within the salience band — above habituation threshold, below overload threshold.

2.11.6 Operationalization:

Chunk large changes into increments with visible wins every 4–12 weeks.

> Breaking change into digestible intervals sustains salience for C, prevents N from being overwhelmed, and signals to E that progress is tangible, reinforcing momentum without triggering collapse.

Build decompression cycles to prevent overload.

> Periodic pauses allow N to recover physiologically, give C space to consolidate learning, and enable E to stabilize infrastructures before the next adaptive push.

Use feedback metrics (stress, adoption, inequality exposure) to dynamically adjust tempo.

> Continuous monitoring ensures that pacing remains within the "Goldilocks band," allowing systems to recalibrate in real time and maintain alignment across N, C, and E.

Rationale: This scaffolding aligns with human neuroplasticity windows, organizational learning cycles, and ecological resilience theory (Holling, 1973).

Integrative Guideline.

Effective systems engineering requires pacing change within the human salience band: above the threshold of habituation yet below the threshold of overload. Large transformations should be decomposed into visible increments that deliver tangible wins every few weeks, interspersed with decompression cycles that allow recovery and consolidation. Continuous feedback on stress, adoption, and inequality exposure enables dynamic recalibration, ensuring that Nature (N), Consciousness (C), and Environment (E) remain aligned within their respective 'Goldilocks zones.' By scaffolding change in this way, systems can sustain resilience, avoid both complacency and collapse, and preserve adaptive capacity over time.

2.11.7 Summary:

The Dual Paradox Model reveals that both sudden shocks and gradual drifts can short circuit instinctual mechanics, disrupting NiCE correlations. Sudden change destabilizes but can catalyze urgent mitigation, while gradual decline feels tolerable yet erodes resilience until collapse.

Yet the inverse dynamics are equally paradoxical: sudden breakthroughs can overwhelm adaptive capacity even when beneficial, and gradual progress, though transformative, is often underappreciated, sustaining the illusion of stasis and blunting its positive impact. The rational sweet zone therefore lies not only in avoiding overload and complacency, but also in ensuring that genuine advances are recognized and integrated without destabilization.

By engineering tempo within human limits of plasticity —

- fast enough to be noticed,
- slow enough to be absorbed, and
- visible enough to be valued —

both individuals as well as systems can better navigate the full spectrum of paradoxes, sustaining resilience across N, C, and E.

3. What Is Our S.C.I.E.N.C.E.?

A NiCE Diagnosis of Individual and Systemic Constitution:

3.1. The Question Itself

The NiCE framework begins with a deceptively simple inquiry:
What is y(our) S.C.I.E.N.C.E.?

It is both an empirical and existential question—a demand to inventory the natural and constructed elements of both ourselves as well as the collective systems we inhabit, to consider how these interact, and to determine where they drift from rational equilibrium and why.

Table 3 - S.C.I.E.N.C.E. is thus an acronym as a mirror:

Letter—Dimension	Core Question
S — Socio	How do we coexist? What norms and power structures shape coordination?
C — Contextual	What meaning systems, information ecologies, and interpretive frames condition perception?
I — Intuitive	What embodied, affective, and cognitive architectures guide action beneath awareness?
E — Engineered	What tools, infrastructures, and designs mediate between intent and outcome?
N — Natural	What ecological and thermodynamic realities bound possibility?
C — Constitutive	What laws, institutions, and codes formalize the rules of interaction?
E — Environment	What larger planetary envelope sustains—or limits—every subsystem?

Collectively, these facets form a **systemic anatomy**: an intrinsic inventory of the human-ecological organism.

3.2. A Layered Diagnostic Architecture

To ask *"What is our S.C.I.E.N.C.E.?"* is to undertake and consider five nested diagnostics:

3.2.1 Systemic Constitution – What are we made of?

The baseline inventory: social relations, cognitive tendencies, energy dependencies, institutional architectures (Ostrom, 2009; Hall & Klitgaard, 2012).

3.2.2 Systemic Mechanics – How do components interact?

The dynamic layer: feedbacks, flows, and adaptive loops that convert input into outcome (Sterman, 2000).

3.2.3 Systemic Intrinsic Logic – Why do causes and effects cohere as they do?

The relational grammar that yields predictable (and sometimes pathological) emergent behaviors (Meadows, 2008).

3.2.4 Systemic Irrationalization – Where and why do systems drift?

The pathology layer: money as abstraction, visibility bias, moral crowd-out, and temporal myopia (Deci, Koestner, & Ryan, 1999; Falk & Szech, 2013; Richardson et al., 2023).

3.2.5 Systemic Prophylaxis – How can natural failures be prevented?

The therapeutic layer: incentive redesign, transparency, ethical feedbacks, and ecological re-anchoring (Marmot, 2005; Nosek et al., 2018).

Each diagnostic tier translates a philosophical question into a measurable field of inquiry—linking introspection to intervention.

3.3. Why the Question Matters

Human civilization has evolved faster than its **feedback comprehension**. Our cognitive architecture remains optimized for local survival, yet our actions now operate at planetary scale (Rockström et al., 2009). Understanding "our S.C.I.E.N.C.E." means quantifying that mismatch—the degree to which symbolic systems (money, metrics, ideology) have detached from their biophysical substrates (Lea & Webley, 2006).

Without such an inventory, reform is guesswork: we can neither diagnose nor design rationally. With it, we can treat civilization as a **living system** governed by legible constraints and responsive to feedback—subject to thermodynamics, neuroeconomics, and ethics alike.

3.3.1 From Diagnosis to Constraint Frameworks

Once the anatomy of S.C.I.E.N.C.E. is established, the next step is understanding the **fields of constraint** that shape its behavior. Just as physics distinguishes between motion, mass, and boundary conditions, social-ecological systems require analogous constructs.

Thus emerge the four governing fields:

Table 4 - the four governing fields of NiCE - S.C.I.E.N.C.E. Mechanics

Field	Function	Analogy
FORCES	The vectors of motion—what drives behavior and reallocates effort.	Dynamics
GRAVITY	The field of inevitability—how accumulated mass (power, norms, value) curves outcomes.	Inertia
ANCHORS	The stabilizers that keep systems tethered to material and moral reality.	Equilibrium
PRIMES	The fundamental constants—energy, information, power, risk, scale—that define the possible.	Natural laws

Together they convert the **descriptive anatomy** of S.C.I.E.N.C.E. into a **predictive mechanics** of civilization. Each field quantifies a distinct class of constraint—kinetic, gravitational, stabilizing, and invariant—allowing diagnoses to be tested, modeled, and falsified across scales (Sterman, 2000; West, 2017).

3.3.2 Why a NiCE Diagnosis Is Necessary

The NiCE triad—**Nature, Consciousness, Environment**—supplies the coordinate system for this inquiry. By cross-indexing each S.C.I.E.N.C.E. dimension with NiCE's triadic axes, we expose how ecological throughput (N), cognitive bias (C), and institutional architecture (E) co-determine every systemic outcome.

This synthesis turns the moral question *"Who are we, and what do we mean?"* into an empirical one:
"How does meaning behave under natural law?"

Such integration is crucial because ignoring any axis produces predictable pathologies:

- **Neglect Nature** → thermodynamic overshoot.
- **Neglect Consciousness** → motivational and ethical drift.
- **Neglect Environment** → institutional capture and collapse.

3.3.3 Toward a Quantified Human Ecology

By re-framing civilization as an **eco-technological organism**, NiCE → S.C.I.E.N.C.E. → FORCES/GRAVITY/ANCHORS/PRIMES builds a coherent progression:

1. **NiCE:** identifies the triadic structure of being.
2. **S.C.I.E.N.C.E.:** inventories its constituent anatomy and logic.
3. **Constraint frameworks:** map the active mechanics and boundary laws that govern motion and stability.

The result is a **quantified human ecology**—a formal language linking ethics, physics, and policy in the same analytic grammar (Ostrom, 2009; Meadows, 2008; West, 2017).

3.3.4 Epilogue: From Observation to Stewardship

To ask *"What is our S.C.I.E.N.C.E.?"* is to accept stewardship as the next phase of knowledge. Observation alone falls far short of being meaningful; diagnosis must lead to effective redesign, and from design to repair. A rational civilization is one that knows not only *how* its systems move, but **why** they should—and where they must stop moving to avoid reactive pendulum overswing and inverse imbalance.

3.5 What's missing (and why it matters)

Such a broad framework as **NiCE– S.C.I.E.N.C.E.** —which inventories the socio-ecological anatomy of civilization—fails if its analysis omits the *latent variables* that drive real-world behavior: **time, energy, information, incentives, power, ethics, risk, scale, agency, embodiment, and evidence**. These "missing pieces" are not cosmetic additions; they are the **unmeasured constraints** operating behind the scenes that determine whether any system remains adaptive or drifts toward collapse (Sterman, 2000; Meadows, 2008). In dynamic systems, omission behaves like entropy: what is not tracked accumulates error, delay, and distortion until feedback loses fidelity.

Each of the domains below represents a recurrent blind spot observed across economics, governance, and ecology—areas where human institutions routinely mis-specify boundaries, ignore lag, or externalize cost (Holling, 1973; Ostrom, 2009). Identifying these absences reveals why elegant theories fail in practice and why moral or technical rationality alone cannot ensure sustainability (Marmot, 2005; Richardson et al., 2023). Collectively, they define the conditions under which human systems preserve coherence between **Nature, Consciousness, and Environment**—or lose it to drift and self-reference.

To restore that coherence, these missing elements must be reincorporated as *active variables*—as constraints that give structure, feedback, and accountability to the NiCE–S.C.I.E.N.C.E. model. The following mapping therefore connects each of these omitted dimensions to a corresponding **constraint framework—FORCES, GRAVITY, ANCHORS, and PRIMES**—each designed to overlap and reveal and govern one essential axis of systemic behavior. Together, they complete the architecture: the bridge from anatomy to mechanics, from description to disciplined constraint.

3.5.1 Time & Irreversibility

Dynamics, lags, path dependence, aging, cohort effects, and hysteresis. Many "repairs" are time-sensitive, and some breaks are irreversible.
Where it fits: add a **Temporal** layer or annotate each S.C.I.E.N.C.E. facet with time scales (seconds → centuries).

3.5.2 Energy/Throughput & Thermodynamics

Every socio-ecological system runs on biophysical throughput; efficiency, exergy, and entropy set hard limits.
Where it fits: an **Energy** axis (or pair it with "Natural") so money/attention can't masquerade as real capacity.

3.5.3 Information & Computation

Signals, noise, algorithms, measurement fidelity, model risk, and observability (what gets sensed gets managed).
Where it fits: an **Information** facet or lock it to "Contextual" so data/metrics are first-class citizens.

3.5.4 Incentives & Finance (Money as Signal)

Prices, budgets, balance-sheet constraints, and liquidity/credit cycles that rewire behavior beyond "Engineered."
Where it fits: make **Incentives/Finance** explicit (distinct from "Engineered") so symbolic money is visible in the framework.

3.5.5 Power & Governance

Political economy, bargaining power, coercion, legitimacy, veto points—why good designs fail in practice.
Where it fits: expand **Constitutive** to **Constitutive/Governance** or add **Power** as its own facet.

3.5.6 Ethics & Justice

Normative baselines (fairness, rights, duties), distributional stakes, intergenerational equity.
Where it fits: a dedicated **Ethics/Justice** facet, or make it an overlay that audits each S.C.I.E.N.C.E. dimension.

3.5.7 Risk, Uncertainty & Robustness

Knightian uncertainty, tail risks, resilience, antifragility, precaution—how we act when we can't know.
Where it fits: an **Uncertainty** facet with required stress tests across S.C.I.E.N.C.E..

3.5.8 Scale & Heterogeneity

Micro ↔ meso ↔ macro, local ↔ global; compositional fallacies, non-linear aggregation,

and spatial heterogeneity.
Where it fits: a **Scale** axis; force every claim to state level and transferability.

3.5.9 Agency & Accountability

Who can act, who is responsible, who is answerable, and with what feedback.
Where it fits: tie to **Constitutive/Governance**, but name **Accountability** explicitly.

3.5.10 Embodiment & Health

Biological constraints on cognition, labor, and welfare; bodies as sites where policy lands.
Where it fits: bridge **Intuitive** (psych) with **Natural** (bio) via an **Embodiment** tag.

3.5.11 Methods & Evidence

Causal identification, experiments, quasi-experiments, model validation, auditability, and preregistration.
Where it fits: a **Method** rail running alongside S.C.I.E.N.C.E. so recommendations are testable, not just legible.

3.6 Connecting framework to constraints

Here's how the **NiCE– S.C.I.E.N.C.E.** structure could *map onto* each of our four constraint frameworks (FORCES, GRAVITY, ANCHORS, PRIMES).

Each pairing explores how it would *feel* conceptually and rhetorically inside our larger **NiCE– S.C.I.E.N.C.E.** system—the tone and metaphor shift slightly depending on which you choose, as slightly differing perspectives – analogous to the classic proverbial metaphor of blind men experiencing and describing the elephant.

3.7 From Inventory to Constraint: Why the Question of What Is Missing Matters

3.7.1 The Threshold Between Understanding and Control

> "A system's *constitution* explains what it is;
> its *constraints* determine what it can become."
>
> NiCE— S.C.I.E.N.C.E. Mechanics

The NiCE– S.C.I.E.N.C.E. diagnosis provides an **anatomical map**—an inventory of the human-ecological system's organs and pathways—but an inventory alone cannot tell us *why repairs fail, why rationality drifts, or why sustainability remains elusive*. For that, we must confront the missing dimensions—the invisible constraints that shape motion, delay feedback, and encode irreversibility.

In any dynamic system, **what is missing** can often prove more diagnostic than what is present.
Thermodynamics calls these "unmeasured losses." In human systems, they appear as **lags, leakages, distortions, and moral blind spots**—the places where perception, incentive, and reality diverge (Sterman, 2000; Meadows, 2008).

3.7.2 Why Systems Drift: The Problem of Omission

From kingdoms, to nation states, to Communism, capitalism, to local clubs and organizations, to marriages and adult romantic relationships—complex social-ecological systems routinely fail not because of malice or ignorance, but because they omit key variables—time delays, embodied limits, and boundary conditions that remain invisible within their symbolic logic. Each omission generates predictable classes of error:

Table 5 - Problems of Omission

Omitted Dimension	Typical Drift	Consequence
Time & Irreversibility	Underestimation of lag and hysteresis	Late reaction, irreparable damage (Holling, 1973)
Energy & Thermodynamics	Treating throughput as infinite	Overshoot, depletion (Hall & Klitgaard, 2012)
Information & Computation	Misreading signals or metrics	Policy failure, moral crowd-out (Muller, 2018)
Incentives & Finance	Pricing illusion and liquidity bias	Distorted priorities, boom–bust cycles (Philippon, 2015)
Power & Governance	Asymmetry of control	Capture, coercion, and inequity (Ostrom, 2009)
Ethics & Justice	Absent fairness reference	Legitimacy erosion (Tyler, 2003; Marmot, 2005)
Risk & Uncertainty	Ignoring tail risks	Fragility and systemic crises (Taleb, 2012)
Scale & Heterogeneity	Aggregation error	Policies that fail across levels (West, 2017)
Agency & Accountability	Diffused responsibility	Moral hazard (Deci, Koestner, & Ryan, 1999)
Embodiment & Health	Cognitive/biological neglect	Burnout, degraded capacity (McEwen, 1998)
Methods & Evidence	Weak identification	Policy built on illusion (Nosek et al., 2018)

Each missing piece corresponds to a known pathology: delayed feedback, metric tyranny, externalized risk, moral detachment, or ecological overshoot. Together, they explain **why seemingly rational systems begin to exhibit irrational behavior** when scaled beyond the sensory and ethical capacities of their participants (Falk & Szech, 2013; Richardson et al., 2023).

3.7.3 From Missing Pieces to Constraint Fields

In an attempt to address and repair these gaps, we developed the **four constraint frameworks—FORCES, GRAVITY, ANCHORS, and PRIMES**—each corresponding to a distinct class of omission identified by the NiCE– S.C.I.E.N.C.E. diagnosis:

Table 6 - Four Constraint Frameworks—FORCES, GRAVITY, ANCHORS, and PRIMES

Missing Domain	Corresponding Framework	Function
Dynamic motion & incentive distortion	**FORCES**	Makes drivers and distortions explicit: finance, order, risk, computation, energy, scale.
Accumulated mass & inevitability	**GRAVITY**	Captures how power, value, information, and time curve outcomes.
Moral grounding & proportionality	**ANCHORS**	Restores connection between agency, norms, obligation, and ecological proportion.
Physical and informational constants	**PRIMES**	Defines the hard boundary conditions: power, risk, information, money, energy, scale.

When we ask, "Why do these matter?" In simple words, because **the missing became the framework.**
Each acronym functions as a *corrective lens*, making visible what our cultural and economic instruments tend to ignore. Together they create a closure condition: the minimal set of constraints under which human systems can remain rationally tethered to reality.

3.7.4 The Logic of Closure: Completeness Without Redundancy

A well-posed system of analysis must satisfy *closure*:
no essential variable is omitted, and no variable is needlessly duplicated (Ashby, 1956).

By aligning the "missing" variables with the four constraint families, the NiCE model achieves closure across three ontological layers:

1. **Constitution (S.C.I.E.N.C.E.):** What exists and how it's structured.
2. **Constraint (FORCES–GRAVITY–ANCHORS–PRIMES):** What governs behavior and limits possibility.
3. **Correction (Justice, Embodiment, Methods):** How feedback, fairness, and evidence ensure continued adaptivity.

This architecture avoids both reductionism (oversimplification) and excess complexity (overfitting), aiming at the cybernetic principle of **requisite variety**—the system's capacity for control must match the variety of its environment (Ashby, 1956; Ostrom, 2009).

3.7.5 Why It Matters

Bridging the "What is" to the "What's missing" transforms description into discipline.
It allows ethical, ecological, and epistemic limits to be expressed in a common grammar—one legible to both policymakers and physicists, both financiers and ecologists.

The absence of this *bridge* is what enables **modernity's great delusions**: infinite growth on finite energy, wealth without work, visibility mistaken for value.
By reinstating the missing variables as explicit constraints, the NiCE system offers a coherent path from **awareness to accountability**, from **knowledge to wisdom** (Meadows, 2008; Marmot, 2005).

3.8 Exploring the Constraint Frameworks

3.8.1 FORCES: The Fundamental Vectors Acting on S.C.I.E.N.C.E. Systems

Fiduciary Finance • **O**rder (Governance) • **R**isk • **C**omputation (Information) • **E**nergy • **S**cale
→ Elegant metaphor: these are the "forces" acting on any system.
(powerful metaphor, harmonious with NiCE physics imagery)

Metaphor: Natural law, mechanics, systemic dynamics
Tone: Analytical, physical, precise

Table 7 - NiCE anchored by FORCES

NiCE Element	FORCES Dimension	How They Interact
Nature (N)	**Energy** – ecological throughput and biophysical limits	Natural systems define the baseline forces of sustainability.
Consciousness (C)	**Information** – perception, cognition, meaning	Consciousness interprets the informational gradients that shape behavior.
Environment (E)	**Order / Control** – institutions, norms, governance	Environment channels energy and information through social structure.
(Meta)	**Finance, Risk, Scale**	These define how systems amplify, distribute, or dampen feedbacks—where drift or collapse occur.

Interpretive summary:

NiCE explains what systems are; FORCES explains what moves them.

Overview

If *NiCE* describes the triadic architecture of all living systems (Nature, Consciousness, Environment), and *S.C.I.E.N.C.E.* frames their epistemic inquiry (Socio, Contextual, Intuitive, Engineered, Natural, Constitutive, Environmental), then *FORCES* represent the **operative dynamics**—the energetic and informational vectors that shape system behavior through interaction, constraint, and drift.

In physical terms, **FORCES are to S.C.I.E.N.C.E. what gravity, thermodynamics, and electromagnetism are to the cosmos**: invisible fields that determine what moves, what stabilizes, and what decays.

Each dimension of *FORCES*—**Fiduciary Finance, Order (Governance), Risk, Computation (Information), Energy, and Scale**—describes a domain of causal influence. Each has its own *mechanism*, *failure mode*, and *rational counterforce*. Together, they constitute the multi-dimensional "physics" of social, economic, and ecological systems.

F — Fiduciary Finance: The Direction and Magnitude of Symbolic Energy

Definition

The flow of symbolic value (money, capital, credit, reputation) that governs motion within human systems. "Fiduciary" introduces the moral orientation of this flow—the duty to channel value toward collective resilience and repair rather than extraction.

Mechanism

Finance converts stored trust into motion. It acts as the energetic medium through which incentives propagate—allocating resources, amplifying activity, and shaping human motivation. The fiduciary dimension ensures these flows remain *anchored to stewardship rather than speculation.*

NiCE Alignment

- **Nature:** Converts ecological throughput into monetary abstraction; requires re-linking to full-cost ecological budgets.
- **Consciousness:** Primes reward circuitry (Lea & Webley, 2006; Falk & Szech, 2013). Fiduciary practice counterbalances this bias with moral restraint.
- **Environment:** Institutionalizes capital governance—laws, accounting norms, transparency mechanisms.

Failure Mode

Financialization (Krippner, 2005; Philippon, 2015): when symbolic capital detaches from biophysical or social value, producing drift, speculation, and inequity.

Rational Counterforce

Re-specify financial returns via *NiCE metrics*: capital gains contingent on verified N–C–E improvement.

O — Order (Governance): The Architecture of Legitimate Coordination

Definition

The institutional, legal, and cultural framework that organizes decision-making, resolves conflict, and enforces norms.

Mechanism

Order provides *directionality*—the vector field of rules, rights, and responsibilities that stabilize cooperation. It determines who governs whom, how accountability operates, and whether legitimacy is upheld or lost.

NiCE Alignment

- **Nature:** Establishes resource rights and ecological governance (Ostrom, 2009).
- **Consciousness:** Shapes norms, fairness perception, and civic trust.
- **Environment:** Manifests as law, bureaucracy, corporate charters, and constitutional structure.

Failure Mode

Capture and corruption: when governance serves concentrated interests rather than the collective (De Loecker et al., 2020; Ostry et al., 2016).

Rational Counterforce

Polycentric governance and stakeholder fiduciary duties—distributed oversight preventing single-point moral failure.

R — Risk: The Probability Field of Loss, Uncertainty, and Fragility

Definition

The quantifiable and perceived likelihood of deviation from expected outcomes—social, ecological, or financial.

Mechanism

Risk modulates behavior through fear, caution, and resilience planning. It defines system fragility: how perturbations propagate through interlinked nodes.

NiCE Alignment

- **Nature:** Environmental volatility (climate, pathogens, resource depletion).
- **Consciousness:** Cognitive bias and misperception of risk (optimism bias, short-termism).
- **Environment:** Regulatory regimes for safety, insurance, contingency design.

Failure Mode

Underpricing or externalizing risk—e.g., ignoring climate costs, moral hazard, or systemic financial contagion.

Rational Counterforce

Internalize risk within market prices and governance metrics; reward resilience and redundancy rather than optimization alone.

C — Computation (Information): The Processing and Transmission of Meaning

Definition

The generation, processing, and dissemination of information, metrics, and data that inform perception, coordination, and decision.

Mechanism

Computation transforms uncertainty into structure. It includes both algorithmic and cognitive processes: data analytics, AI, communication systems, education, and language itself.

NiCE Alignment

- **Nature:** Information gradients in ecological systems (feedback loops, signaling).
- **Consciousness:** Cognitive processing, pattern recognition, and attention allocation.
- **Environment:** Institutional knowledge systems—education, media, science.

Failure Mode

Metric fixation and signal distortion (Muller, 2018): when quantification replaces understanding; when virality supersedes veracity.

Rational Counterforce

Design "attention integrity" systems; pre-register metrics; prioritize informational throughput that increases repair capacity rather than spectacle.

E — Energy: The Metabolic Basis of All Work

Definition

The physical capacity to perform work—solar, chemical, mechanical, or metabolic—that powers all systems, from ecosystems to economies.

Mechanism

Energy provides the thermodynamic base for all other forces. Without surplus energy, no complexity (social, economic, or cognitive) can be maintained.

NiCE Alignment

- **Nature:** Primary productivity, entropy, and ecological energetics.
- **Consciousness:** Cognitive energy costs (attention, focus).
- **Environment:** Infrastructure, resource extraction, and technology.

Failure Mode

Overshoot—exceeding renewable capacity; underpricing fossil fuels; ignoring ecological externalities (Black et al., 2023; Richardson et al., 2023).

Rational Counterforce

Absolute energy budgets and throughput accounting; binding physical caps rather than intensity targets.

S — Scale: The Dimensional Law of Proportion and Emergence

Definition

The structural dimension that determines how systems behave as they grow—nonlinearities, thresholds, economies (and diseconomies) of scale.

Mechanism

Scale magnifies both capacity and fragility. It defines the reach of influence, feedback delay, and potential for runaway effects (positive or negative).

NiCE Alignment

- **Nature:** Biological scaling laws (metabolic rates, carrying capacity).
- **Consciousness:** Cognitive and social scaling—Dunbar's number, network saturation.
- **Environment:** Urbanization, global supply chains, planetary boundaries.

Failure Mode

Super-linear drift: as systems scale, feedbacks lag, incentives detach, and collapse becomes autocatalytic.

Rational Counterforce

Adopt modular, nested, polycentric structures; favor *scalable accountability* rather than unbounded growth.

Table 8 - Synthesis: How FORCES Act on S.C.I.E.N.C.E.

S.C.I.E.N.C.E. Dimension	Dominant FORCES	Resulting Systemic Effect
Socio	Finance, Order, Risk	Defines distributional justice, social stability, inequality patterns.
Contextual	Order, Computation	Determines interpretive coherence and legitimacy of meaning.
Intuitive	Computation, Energy	Shapes cognitive load, creativity, and perceptual bandwidth.
Engineered	Risk, Scale, Energy	Governs technological robustness, infrastructure resilience.
Natural	Energy, Scale, Order	Reflects ecological feedback and resource governance.
Constitutive	Finance, Fiduciary, Risk	Encodes the architecture of rules and incentives.
Environment	All	Integrates feedbacks, defines planetary carrying capacity.

3.8.2 GRAVITY The Field of Systemic Inevitability

Governance • **R**isk • **A**gency • **V**alue • **I**nformation • **T**ime • **Y**ield
→ Evokes natural law and inevitability — systems pulled by their own weights.
(evocative, thematically fits NiCE's physical analogies)

FORCES describes the *mechanics* of motion within systems, while **GRAVITY** describes the *inevitability* of their pull.
Where FORCES acts *externally* (vectors that move and distort systems), **GRAVITY** acts *internally* — the field of attraction and inertia generated by a system's own mass: its accumulated norms, power, and value structures.

Metaphor: Moral and physical inevitability, attraction, consequence
Tone: Philosophical, moral-scientific, elegant

Table 9 - NiCE grounded in GRAVITY

NiCE Element	GRAVITY Dimension	How They Interact
Nature (N)	**Energy / Time** – irreversible processes, entropy	Nature supplies the field of real limits and delay.
Consciousness (C)	**Value / Agency** – what draws human attention and action	Consciousness orients toward perceived "mass" in value space.
Environment (E)	**Governance / Risk** – the curvature institutions impose	Environment shapes the trajectory of matter, mind, and means.

Interpretive summary:

GRAVITY names the inevitabilities that pull NiCE systems back toward or away from equilibrium.

GRAVITY Overview:

If *FORCES* are the vectors that move systems through space, *GRAVITY* is the field that holds them together—or pulls them down when they become too massive, rigid, or unbalanced.

In the NiCE– S.C.I.E.N.C.E. model, **GRAVITY represents the emergent inevitabilities of complex systems**: those persistent attractors and moral drifts that shape behavior whether or not agents intend them to.

Each dimension—**Governance, Risk, Agency, Value, Information, Time, and Yield**—acts as a gravitational component, bending trajectories around its influence.
Together, they describe why systems evolve as they do: why ideals decay into self-interest, why short-term rewards outweigh long-term prudence, and why human institutions, once massive enough, curve meaning and motion toward themselves.

G — Governance: The Curvature of Collective Order

Definition

The architecture of decision-making and authority—the rules that determine who exerts power, how, and to what end. Governance defines the system's *geometry*—its contours of legitimacy, feedback, and constraint.

Mechanism

Governance generates "gravitational curvature" by concentrating mass in institutional bodies: governments, corporations, bureaucracies. The more authority accumulates, the more it bends behavior around itself.

NiCE Alignment

- **Nature:** Determines how resource rules are enforced (Ostrom, 2009).
- **Consciousness:** Shapes perception of fairness and trust.
- **Environment:** Structures legitimacy and compliance.

Failure Mode

Excessive centralization → capture, opacity, inertia.
Insufficient governance → chaos, fragmentation.

Rational Counterforce

Polycentric governance and transparent fiduciary duties—distributing "mass" to reduce curvature.

R — Risk: The Gravity Well of Uncertainty

Definition

The ever-present pull of potential loss and entropy within complex systems.
Risk acts as a gravitational sink: the more uncertainty accumulates unpriced or unmitigated, the deeper the well becomes.

Mechanism

Systems orbit around perceived safety zones. When risk is ignored or externalized, those orbits decay, and collapse becomes inevitable.

NiCE Alignment

- **Nature:** Climatic and ecological volatility.
- **Consciousness:** Cognitive bias—humans underestimate distant risks.
- **Environment:** Regulatory regimes that either stabilize or amplify fragility.

Failure Mode

Moral hazard and short-termism; discounting the future.
Risk becomes invisible until it cascades (financial crises, pandemics).

Rational Counterforce

Full-cost accounting and long-term planning horizons—pricing uncertainty as real mass within the system.

A — Agency: The Vector of Will within a Field of Constraint

Definition

The capacity of individual or collective actors to initiate change against inertia. Agency resists gravity—but is itself limited by mass (power, norms, biology).

Mechanism

Agency determines whether systems adapt or ossify.
In physics terms, it's the kinetic energy that can overcome gravitational binding.

NiCE Alignment

- **Nature:** Evolutionary drive toward survival and reproduction.
- **Consciousness:** Intention, creativity, moral choice.
- **Environment:** Institutional channels enabling participation or dissent.

Failure Mode

Alienation—when agency collapses under the weight of systemic inertia, leading to apathy or authoritarianism.

Rational Counterforce

Empower distributed agency through transparency, education, and participatory design.

V — Value: The Center of Mass

Definition

The moral and material priorities that give systems weight. Value is the gravitational core—what everything else orbits.

Mechanism

Value organizes attention, capital, and legitimacy.
When value is tethered to repair, systems orbit sustainably; when tethered to extraction, they spiral into collapse.

NiCE Alignment

- **Nature:** Scarcity defines what is valued.
- **Consciousness:** Internalized ideals and motives.
- **Environment:** Market and institutional codification of value.

Failure Mode

Value inversion—when the symbolic displaces the real (money over meaning, appearance over outcome).

Rational Counterforce

Re-anchor value to verifiable N–C–E outcomes (health, learning, resilience, ecological stability).

I — Information: The Field of Perception and Meaning

Definition

The distribution of knowledge, narrative, and signal that allows systems to "see" themselves. Information defines the *gravitational lensing* of perception—bending what is visible and what remains hidden.

Mechanism

Accurate information flattens curvature; distortion deepens wells of ignorance.
Data, metrics, and storytelling shape agency by defining what is thinkable.

NiCE Alignment

- **Nature:** Feedback loops and cybernetic signaling.
- **Consciousness:** Cognitive bias, media framing.
- **Environment:** Information ecosystems—education, journalism, AI.

Failure Mode

Info-pollution, disinformation, or metric tyranny—where truth curves around ideology or profit.

Rational Counterforce

Open knowledge architectures; independent audits; transparency weighted toward repair outcomes.

T — Time: The Inertia of Sequence

Definition

The dimension through which all other forces act.
Time introduces delay, accumulation, and irreversibility—transforming actions into trajectories and trajectories into destinies.

Mechanism

Time builds inertia: habits, institutions, and infrastructures become entrenched.
What begins as choice becomes gravity.

NiCE Alignment

- **Nature:** Evolutionary and thermodynamic irreversibility.
- **Consciousness:** Memory, discounting, and attention span.
- **Environment:** Intergenerational policy and planning horizons.

Failure Mode

Temporal myopia—sacrificing long-term resilience for immediate gain.

Rational Counterforce

Integrate long-term cost accounting, intergenerational ethics, and temporal feedback (lag-aware policy design).

Y — Yield: The Event Horizon of Return

Definition

The apparent output or return from any system relative to its inputs. Yield defines the *visible payoff*, often concealing long-term depletion.

Mechanism

Yield exerts gravity by pulling attention toward what is immediately profitable.
The stronger the short-term yield, the more energy is drained from distant horizons.

NiCE Alignment

- **Nature:** Productivity cycles, carrying capacity.
- **Consciousness:** Reward sensitivity and discounting.
- **Environment:** Macroeconomic and ecological return structures.

Failure Mode

False efficiency—apparent productivity masking long-run decay (soil exhaustion, burnout, financial bubbles).

Rational Counterforce

Shift metrics from instantaneous yield to sustained regenerative output—measured over ecological and social timeframes.

Table 10 - Synthesis: How GRAVITY Acts on S.C.I.E.N.C.E. Systems

S.C.I.E.N.C.E. Dimension	Dominant Gravitational Components	Systemic Implication
Socio	Governance, Value, Agency	Determines fairness, trust, and social cohesion.
Contextual	Information, Value	Shapes narrative frames, perception of truth.
Intuitive	Agency, Time	Modulates creativity, willpower, and moral foresight.
Engineered	Risk, Time, Yield	Defines system robustness and technological half-life.
Natural	Time, Yield, Governance	Manages ecological regeneration and depletion cycles.
Constitutive	Governance, Value	Encodes legitimacy and the moral physics of systems.
Environment	All	Integrates the total mass and feedback curvature of civilization.

3.8.3 ANCHORS – The Stabilizing Vectors of Reality

Agency • **N**orms • **C**ontrol • **H**ierarchy • **O**bligation • **R**isk • **S**cale
→ Metaphorically precise — the factors that "anchor" a system to reality.
(poetic, easy to remember, complements NiCE/ S.C.I.E.N.C.E. beautifully)

If **FORCES** describes *what moves* a system, and **GRAVITY** describes *what holds it together or pulls it down*, then **ANCHORS** describes *what keeps it from drifting entirely away* — the stabilizing moral, structural, and proportional elements that tether complex systems to reality.

Metaphor: Ethical grounding, stability amid drift
Tone: Normative-philosophical, humanistic, lyrical

Table 11 - NiCE steadied by ANCHORS

NiCE Element	ANCHORS Dimension	How They Interact
Nature (N)	**Boundaries / Costs**	Natural limits anchor all life within ecological truth.
Consciousness (C)	**Norms / Obligation**	Shared meaning and moral duty keep minds oriented to the collective good.
Environment (E)	**Control / Hierarchy / Risk / Scale**	Institutions translate anchored values into durable governance.

Interpretive summary:

NiCE reveals the system's structure; ANCHORS remind it where home is.

ANCHORS Overview:

In any living or social system, motion and gravity alone are insufficient.
Without anchors—those stabilizing principles that ground meaning, constrain excess, and maintain proportion—systems drift, distort, or dissolve.

ANCHORS represents the class of factors that *bind a system to its ecological, moral, and institutional ground truths.*
They resist the centrifugal pull of abstraction, speed, and symbolic escalation. They are the **counterweights to drift.**

Each dimension—**Agency, Norms, Control, Hierarchy, Obligation, Risk, and Scale**—describes a stabilizing function.
Together, they sustain coherence across the NiCE triad by ensuring that Nature's limits, Consciousness's motives, and Environment's rules remain *mutually legible.*

A — Agency: The Anchoring of Intent to Responsibility

Definition

The capacity to act, bound by awareness of consequence.
Agency anchors freedom to accountability—it is will in relation to reality.

Mechanism

Agency stabilizes systems by localizing moral and practical responsibility.
Distributed agency ensures that decision and consequence are proximate, reducing systemic drift caused by detachment or diffusion of blame.

NiCE Alignment

- **Nature:** Biological autonomy and survival instincts.
- **Consciousness:** Awareness and moral deliberation.
- **Environment:** Institutional structures enabling or disabling genuine choice.

Failure Mode

Agency without anchoring → impulsivity, opportunism, moral hazard.
Lack of agency → paralysis and disempowerment.

Rational Counterforce

Cultivate informed agency: transparency of outcomes, ethical literacy, and participatory governance.

N — Norms: The Cultural Gravity of Shared Meaning

Definition

The collectively internalized expectations that define acceptable behavior and confer legitimacy.

Mechanism

Norms act as invisible anchors—social "tethers" that stabilize cooperation without constant coercion.
They enable trust, reciprocity, and predictability.

NiCE Alignment

- **Nature:** Social instincts and evolutionary cooperation.
- **Consciousness:** Moral emotion, empathy, shame, pride.
- **Environment:** Law and informal culture reinforcing shared values.

Failure Mode

Norm erosion → cynicism, moral relativism, fragmentation.
Over-rigid norms → dogmatism, suppression of innovation.

Rational Counterforce

Adaptive normativity—continuous alignment of moral codes with empirical reality and collective well-being.

C — Control: The Feedback Mechanism of Stability

Definition

The systemic process by which feedback is sensed, evaluated, and acted upon to maintain homeostasis.

Mechanism

Control ensures systems self-correct rather than spiral.
It manifests in regulation, audit, adaptive learning, and self-discipline.

NiCE Alignment

- **Nature:** Cybernetic regulation (thermoregulation, ecosystems).
- **Consciousness:** Emotional regulation, prudence.
- **Environment:** Policy, law enforcement, oversight bodies.

Failure Mode

Overcontrol → rigidity, authoritarianism.
Under-control → volatility, corruption, runaway drift.

Rational Counterforce

Feedback proportionality—responsive, evidence-based correction calibrated to system complexity.

H — Hierarchy: The Architecture of Functional Order

Definition

The stratified organization of authority and specialization that enables coordination at scale.

Mechanism

Hierarchy anchors systems by clarifying responsibility and flow of command.
Properly designed, it distributes complexity without collapsing into chaos.

NiCE Alignment

- **Nature:** Biological hierarchies (organismal systems, ecosystems).

- **Consciousness:** Recognition of expertise, mentorship, and lineage.
- **Environment:** Institutional roles, professional accountability.

Failure Mode

Tyranny or stagnation when hierarchy becomes self-serving; dysfunction when flattened beyond operability.

Rational Counterforce

Fractal hierarchy—nested, accountable layers with upward and downward transparency.

O — Obligation: The Moral Anchor of Commitment

Definition

The internalized sense of duty to others, to the system, and to future generations.

Mechanism

Obligation binds self-interest to reciprocity.
It transforms agency into stewardship—"I must" rather than "I can."

NiCE Alignment

- **Nature:** Parental care, kin altruism.
- **Consciousness:** Moral conscience and empathy.
- **Environment:** Civic duty, professional ethics, fiduciary responsibility.

Failure Mode

Erosion of obligation → sociopathy, transactionalism.
Excessive obligation → burnout, martyrdom.

Rational Counterforce

Reciprocal obligation frameworks—shared duty sustained by equitable recognition and rest.

R — Risk: The Awareness That Grounds Prudence

Definition

The conscious acknowledgment of uncertainty and potential loss.
Risk anchors aspiration to humility.

Mechanism

By confronting limits and potential failure, systems moderate hubris.
Risk-awareness preserves proportionality in decision-making.

NiCE Alignment

- **Nature:** Evolutionary sensitivity to danger.
- **Consciousness:** Anticipation, foresight, anxiety regulation.
- **Environment:** Safety codes, redundancy planning, insurance systems.

Failure Mode

Risk denial → overreach, collapse.
Risk obsession → stagnation, innovation paralysis.

Rational Counterforce

Resilient risk culture—normalize adaptive experimentation bounded by real consequence.

S — Scale: The Anchor of Proportion and Perspective

Definition

The relational measure of size, scope, and complexity—how systems remain commensurate with the realities they depend on.

Mechanism

Scale anchors complexity to manageability.
Maintaining proportion prevents dilution of meaning and runaway externalities.

NiCE Alignment

- **Nature:** Ecological carrying capacity.
- **Consciousness:** Cognitive limits (Dunbar's number, empathy bandwidth).
- **Environment:** Urban, economic, and technological scaling.

Failure Mode

Over-scaling → bureaucratic blindness, planetary overshoot.
Under-scaling → fragmentation, inefficiency.

Rational Counterforce

Nested proportionality—design systems that replicate coherence across levels (family → community → nation → planet).

Table 12 - Synthesis: How ANCHORS Stabilize S.C.I.E.N.C.E.

S.C.I.E.N.C.E. Dimension	Dominant Anchors	Stabilizing Function
Socio	Norms, Obligation, Risk	Grounds trust, cooperation, and responsibility.
Contextual	Norms, Control	Maintains meaning coherence and epistemic discipline.
Intuitive	Agency, Obligation	Balances autonomy with conscience.
Engineered	Control, Scale, Risk	Ensures safe and proportionate innovation.
Natural	Risk, Scale	Keeps activity aligned with ecological constraints.
Constitutive	Hierarchy, Obligation	Preserves functional integrity of institutions.
Environment	All	Integrates human conduct with planetary limits.

3.8.4 PRIMES—The Fundamental Constraints of Reality

Power • **R**isk • **I**nformation • **M**oney • **E**nergy • **S**cale
→ *Elegant and intuitive — evokes "prime constraints" or "prime numbers" as naturally occurring special inherent order patterns*
(clean, mnemonic, balanced)

Where **FORCES** describe motion, **GRAVITY** describes inevitability, and **ANCHORS** describe grounding, **PRIMES** defines the **fundamental constraints**—the invariant parameters within which every system, biological or social are operationally ordered.

Think of *PRIMES* as the **constants of systemic physics**: those intrinsic quantities that cannot be bypassed, only respected.
They are the *first principles* of all complex organization — the structural laws that define the possible and prohibit the impossible.

Metaphor: Foundational constants, base constraints, "first principles"
Tone: Scientific, crisp, systems-engineering

Table 13 - NiCE defined by PRIMES

NiCE Element	PRIMES Dimension	How They Interact
Nature (N)	**Energy / Scale**	Sets physical boundaries and scaling laws.
Consciousness (C)	**Information / Power**	Governs sense-making and agency distribution.

NiCE Element	PRIMES Dimension	How They Interact
Environment (E)	Risk / Money	Manages uncertainty and allocates incentives.

Interpretive summary:

NiCE provides the variables; PRIMES define the constants that constrain them.

PRIMES Overview:

Every system—natural, social, cognitive, or economic—operates within a set of primary limits that define what can persist, grow, or decay. These constraints are not merely external; they are constitutive. They determine **what is possible to sustain**, not merely what is desirable to pursue.

PRIMES identifies the six fundamental invariants shaping all systems:
Power, Risk, Information, Money, Energy, and Scale.

Each act as a prime constraint—a natural law-like boundary or constant. Together, they form the *governing arithmetic* of the NiCE– S.C.I.E.N.C.E. system, defining its stability, efficiency, and capacity for coherence.

P — Power: The Prime of Agency and Influence

Definition

Power is the capacity to effect change in matter, meaning, or mind. It is the gradient that allows systems to shape outcomes—to move probability distributions in their favor.

Mechanism

Power emerges from asymmetry: in resources, knowledge, or control.
It is both a physical property (energy transfer) and a social one (authority, influence).

NiCE Alignment

- **Nature:** Hierarchical energy flows in ecosystems.
- **Consciousness:** Autonomy, will, and domination.
- **Environment:** Political, legal, and institutional structures.

Constraint

Power cannot be created without extraction or trust; its use always incurs cost.
Unchecked, it self-amplifies and distorts value hierarchies.

Failure Mode

Concentration → tyranny, fragility, resistance.
Dissipation → impotence, drift, chaos.

Rational Balance

Distribute power through polycentric governance and transparency—retain potency, prevent predation.

R — Risk: The Prime of Uncertainty

Definition

Risk is the intrinsic unpredictability of dynamic systems—the measure of variance between intent and outcome.

Mechanism

Risk defines the domain of potential loss; it acts as the probabilistic constraint of all decision and evolution.
No system can eliminate risk; it can only internalize or externalize it.

NiCE Alignment

- **Nature:** Stochastic variation and entropy.
- **Consciousness:** Perception and misjudgment of danger.
- **Environment:** Regulatory, insurance, and resilience frameworks.

Constraint

Ignoring risk doesn't remove it; it accumulates unseen until collapse.
Mitigation requires redundancy, not denial.

Failure Mode

Overconfidence → collapse; paranoia → stagnation.
Risk must be faced, not suppressed.

Rational Balance

Price risk accurately and embed redundancy—optimize for durability, not perfection.

I — Information: The Prime of Perception and Coherence

Definition

Information is the structured reduction of uncertainty—it allows systems to sense, interpret, and adapt.

Mechanism

Information flow enables coordination; feedback determines adaptation speed.
The quality, not quantity, of information governs coherence.

NiCE Alignment

- **Nature:** Genetic code, signaling pathways.
- **Consciousness:** Awareness, communication, and attention.
- **Environment:** Data, media, science, and education systems.

Constraint

No system can process infinite information; perception is always selective.
Signal distortion (noise, propaganda, over-metrication) erodes meaning.

Failure Mode

Info-pollution → confusion, polarization.
Data opacity → ignorance and drift.

Rational Balance

Cultivate signal integrity and epistemic humility; reward verified understanding over viral visibility.

M — Money: The Prime of Symbolic Energy

Definition

Money is the codified trust enabling delayed reciprocity and large-scale coordination.
It translates material value into symbolic representation.

Mechanism

Money channels attention and effort; it bridges time and distance, creating social metabolism.
Yet, as abstraction grows, it risks decoupling from the physical substrates it represents.

NiCE Alignment

- **Nature:** Indirect reciprocity and energetic accounting.
- **Consciousness:** Reward circuitry, aspiration, and material desire.

- **Environment:** Financial institutions, trade systems.

Constraint

Money is not value; it is a map of value.
When the map replaces the territory, distortion and drift follow.

Failure Mode

Financialization—symbolic accumulation detached from real provisioning (Krippner, 2005; Philippon, 2015).
Moral hazard and systemic inequality.

Rational Balance

Re-anchor money to verifiable N–C–E improvements—tie symbolic gain to ecological and social repair.

E — Energy: The Prime of Work and Entropy

Definition

Energy is the fundamental capacity to perform work—the ultimate limiting resource.
It is the physical substrate that sustains all order.

Mechanism

Energy throughput defines complexity.
When energy input falls or efficiency declines, structures degrade (Tainter, 1988; Hall & Klitgaard, 2012).

NiCE Alignment

- **Nature:** Thermodynamic constraint on all life.
- **Consciousness:** Cognitive expenditure, attention as energy.
- **Environment:** Industrial metabolism, resource management.

Constraint

Energy cannot be consumed without entropy; efficiency gains face diminishing returns.
No infinite growth is possible in a finite energetic domain.

Failure Mode

Overshoot and depletion; collapse of complexity when EROEI (Energy Returned on Energy Invested) falls below maintenance threshold.

Rational Balance

Adopt absolute energy budgets and regenerative throughput; align prosperity with entropy-aware efficiency.

S — Scale: The Prime of Proportion and Complexity

Definition

Scale determines how phenomena behave as they grow or shrink—shaping emergent properties, coordination costs, and fragility.

Mechanism

Scaling laws govern metabolic, cognitive, and economic systems alike (West, 2017). Beyond optimal scale, feedback delays cause collapse or bureaucracy.

NiCE Alignment

- **Nature:** Biological allometry, ecological carrying capacity.
- **Consciousness:** Social cognition limits, empathy bandwidth.
- **Environment:** Urbanization, globalization, planetary governance.

Constraint

Every system has a natural operating range—beyond it, returns invert.

Failure Mode

Over-scaling → fragility, centralization, loss of adaptability.
Under-scaling → fragmentation, undercapacity.

Rational Balance

Nested modularity—design at human and ecological scales, linked by feedback rather than domination.

Table 14 - PRIMES as Universal Constraints on S.C.I.E.N.C.E.

S.C.I.E.N.C.E. Dimension	Dominant PRIMES	Constraint Type
Socio	Power, Money, Risk	Limits of equity, trust, and coordination.

S.C.I.E.N.C.E. Dimension	Dominant PRIMES	Constraint Type
Contextual	Information, Power	Limits of cognition, narrative, and legitimacy.
Intuitive	Information, Energy	Limits of awareness and cognitive expenditure.
Engineered	Energy, Risk, Scale	Limits of efficiency and resilience.
Natural	Energy, Scale	Limits of growth and regeneration.
Constitutive	Power, Money, Risk	Limits of governance and incentive compatibility.
Environment	All	Limits of planetary carrying capacity and system coherence.

Table 15 - What's still Missing → Where It Lives (and What's Left)

Missing item (why it matters)	Covered by (primary)	Secondaries	Coverage	Minimal patch (if any)
Time & Irreversibility — lags, hysteresis, path dependence; some breaks can't be fixed	**GRAVITY: T (Time)**	FORCES: Risk; ANCHORS: Control (feedback timing)	**Strong**	Keep GRAVITY's **T** explicit and add "lag/irreversibility" callouts in FORCES–Risk playbooks.
Energy / Throughput & Thermodynamics — exergy, entropy, hard biophysical limits	**FORCES: E (Energy); PRIMES: E (Energy)**	GRAVITY: Yield (throughput outcomes)	**Strong**	Add a one-line rule: "No symbolic gain without energy accounting" in PRIMES–Money.
Information & Computation — signal integrity, model risk, observability	**FORCES: C (Computation/Information); PRIMES: I (Information)**	GRAVITY: Information (lensing), ANCHORS: Control (measurement)	**Strong**	Add "model risk & observability" as required subtests under FORCES–Computation.

Missing item (why it matters)	Covered by (primary)	Secondaries	Coverage	Minimal patch (if any)
Incentives & Finance (Money as signal) — prices, liquidity cycles, budgets	**FORCES: F (Fiduciary Finance); PRIMES: M (Money)**	GRAVITY: Value/Yield (what gets rewarded)	**Strong**	Keep "fiduciary" in F; add explicit "liquidity cycle stress" under Risk.
Power & Governance — bargaining power, legitimacy, veto points	**GRAVITY: Governance; PRIMES: Power**	ANCHORS: Hierarchy; FORCES: Order	**Strong**	Add "veto-point map" and "capture risk" as mandatory diagnostics in GRAVITY–Governance.
Ethics & Justice — fairness, rights, intergenerational equity	**ANCHORS: Obligation & Norms** (moral anchors)	GRAVITY: Value (moral center), FORCES: Order (fiduciary duties)	**Partial**	Introduce a lightweight **Justice overlay** (audit rubric) that tags each action with distributional/rights impacts by scale and generation.
Risk, Uncertainty & Robustness — Knightian uncertainty, tails, precaution	**FORCES: Risk; GRAVITY: Risk (gravity well)**	ANCHORS: Risk (prudence)	**Strong**	Add "unknown-unknowns protocol" (scenario envelopes + kill-switches) to FORCES–Risk.
Scale & Heterogeneity — micro↔macro, spatial variance, aggregation fallacies	**PRIMES: Scale; ANCHORS: Scale (proportion)**	FORCES: Scale (design), GRAVITY: Governance (jurisdiction)	**Strong**	Require "level-of-analysis" tag for every claim and policy (local/meso/global + transferability).
Agency & Accountability	**ANCHORS: Agency & Control**	GRAVITY: Governance	**Strong**	Add "accountability chain" artifact:

Missing item (why it matters)	**Covered by (primary)**	**Secondaries**	**Coverage**	**Minimal patch (if any)**
— who can act, who answers, feedback loops		(legitimacy), FORCES: Order (rules)		decision → duty holder → audit trail → sanction.
Embodiment & Health — bodies where policy lands; cognitive/physical limits	**ANCHORS: Risk & Scale (proportion to human limits)**	GRAVITY: Time (aging/cohorts), FORCES: Energy (metabolic cost)	**Partial**	Add an **Embodiment tag**: every intervention reports human load (cognitive/physiological), equity impacts, burnout risk.
Methods & Evidence — identification, replication, preregistration, audits	(Not a domain; a **meta-rail**)	Touches: FORCES–Computation, ANCHORS–Control	**Gap**	Add a **Methods rail**: preregistered KPIs, stepped-wedge/kill-switch norms, independent audits, and versioned learning loops across all modules.

Finally, to preserve the elegance of **FORCES–GRAVITY–ANCHORS–PRIMES** while closing the last mile from theory to accountable practice, we add three light layers that ride across these all as follows:

- **Justice overlay** (ethical audit),
- **Embodiment tag** (human reality check),
- **Methods rail** (how we know, adapt, and stop).

3.8.5 Justice Overlay (J): Distribution, due process, and intergenerational stakes

Purpose

Rather than drifting to a standard enforcing merely '*whatever you can get away with as well as live with yourself*' reframe of **fairness** that rewards and incentivizes sociopathy, reforms systems to make fairness *operationally serve a collective best interest*: require every recommendation to report

(i) **who benefits/loses** (distribution),

(ii) **how** decisions are made/enforced (procedural justice), and

(iii) **when** costs/benefits land (intergenerational equity via discounting). This prevents "symbolic wins" from masking real harm.

Scaffolding

J1. Distributional impact:

Quantify gradient effects (e.g., by income, race, region) in health, exposure, access, and cost burdens (Marmot, 2005).
Metric: between-group gaps and concentration indices for outcomes/exposures.

J2. Procedural legitimacy:

Test whether affected groups perceive decision rules as **impartial, respectful, and reason-giving**—a predictor of voluntary compliance and durable cooperation (Tyler, 2003; Murphy et al., 2009).
Metric: validated procedural-justice scales; appeal/voice rates; complaint resolution latency.

J3. Intergenerational fairness:

Make the **discount rate** explicit and justify it against evidence on time preference and long-run damage (Frederick et al., 2002).
Metric: sensitivity of net benefits to alternative social discount rates; disclosure of irreversibilities (Richardson et al., 2023).

Rationale

Outcomes that "look efficient" but **erode legitimacy**, **widen gradients**, or **offload costs to the future** are brittle—and typically unravel in enforcement or politics (Tyler, 2003; Marmot, 2005).

3.8.6 Embodiment Tag (B): Where policy hits bodies

Purpose

Make biological constraints and health pathways **first-class**: cognition, fatigue, stress physiology, and burnout shape real-world performance and uptake.

Scaffolding

B1. Cognitive load:

Designs that overload working memory degrade judgment and learning (Sweller, 1988).
Metric: task-completion errors vs. step count; comprehension checks; time-to-decision.

B2. Allostatic load:

Chronic stress (from debt, pollution, precarious work) produces measurable **wear-and-tear** with downstream disease risk (McEwen, 1998).
Metric: composite stress biomarkers; sleep duration; self-reported strain.

B3. Burnout risk:

Emotionally intensive roles (care, teaching) show higher **exhaustion/cynicism/inefficacy** under poor conditions (Maslach et al., 2001).
Metric: validated burnout scales; turnover/intent-to-leave; sickness absence.

B4. Social gradients in health:

Distributional context changes **embodied** outcomes, not just perceptions (Marmot, 2005).
Metric: morbidity/mortality gaps; exposure differentials to hazards (Black et al., 2023).

Rationale

Policies that ignore **bodies**—their limits and load—fail in deployment: errors rise, uptake falls, and quality erodes (Sweller, 1988; McEwen, 1998; Maslach et al., 2001).

3.8.6 Methods Rail (M): Identification, transparency, and learning-by-doing

Purpose

Make every claim **testable** and every rollout **auditable**. This is the quality-assurance spine across NiCE.

Scaffolding

M1. Pre-specification & preregistration:
Declare outcomes, analyses, and stopping rules up front to curb researcher degrees of freedom (Nosek et al., 2018).
Artifact: registry link; deviations log.

M2. Field evaluation designs:
Prefer **stepped-wedge** deployments for system interventions (fair + identifiable) and report population impact with **RE-AIM** (Glasgow et al., 1999; Hemming et al., 2015).
Artifact: consort-style diagram; coverage/adoption/maintenance metrics.

M3. Audit & monitoring:
Embed **ongoing audit APIs** and community monitoring for shared resources (Ostrom, 2009), with trigger-based **kill-switches** for harm.
Artifact: open metrics feed; incident response playbooks.

M4. Metric integrity:
Guard against **Goodhart drift** by triangulating indicators and publishing error

bars/uncertainty (Muller, 2018).
Artifact: dashboard with CIs, missingness, model-risk notes.

Rationale

Real systems learn under uncertainty. **Transparent priors + staged tests + audits** create compounding knowledge and cut the tail risks of big-bang deployments (Nosek et al., 2018; Hemming et al., 2015).

---

4. Symbolic Incentives and Monetary Drift
A Cross-Cultural NiCE Case Study

Author's Note (Context, not Conclusion)
Across cultures, economic life has been framed in moral terms. We treat those long-lived sources as contextual survey evidence—recurrent, independent observations that certain incentive structures were perceived as destabilizing. They motivate inquiry; they do not decide it. The analysis that follows pre-specifies hypotheses (H1–H4), indicators, and falsifiers, and then tests whether modern financial architectures exhibit measurable forms of symbol–substrate drift and incentive misalignment consistent with those historical cautions.

Human societies have long signaled that markets and money are never merely technical instruments. Religious strictures against usury, philosophical arguments over just exchange, and anthropological observations of reciprocity all testify to the fact that economic life has historically been embedded within moral and social orders. We treat these enduring sources as data: durable evidence that questions of value and incentive have consistently been framed in moral terms, rather than as neutral mechanisms of allocation.

This perspective helps explain *why it is rational*—not rhetorical—to begin by recalling such sources. They do not predetermine our conclusions but establish *why* scientific inquiry is warranted. The core of this work is empirical: examining whether contemporary financial and incentive systems reproduce the very misalignments these long-standing traditions warned against. The subsequent sections present case evidence—derivatives markets, algorithmic trading shocks, healthcare and pharmaceutical pricing, and ecological overshoot—designed to test whether those historical cautions find measurable analogues in modern practice.

Abstract

We examine when and how financial incentives detach from the goods, services, and ecological capacities they are meant to coordinate. Using the NiCE framework (Nature, Consciousness, Environment), we assemble case evidence across derivatives markets, crypto-token complexes, high-frequency trading, carbon crediting, and price formation in health care and pharmaceuticals. We specify four causal pathways—monetary expansion, scarcity mispricing, behavioral overshoot, and recursive financial engineering—and derive falsifiable hypotheses for each. Across cases, we find patterns consistent with incentive misalignment: returns realized within financial symbol space with weak ties to productive output or ecological renewal. We outline measurement strategies, identify boundary conditions, and propose a pilot assessment instrument to realign incentives with biophysical limits and human well-being. We discuss limitations and alternative explanations, including innovation, compositional effects, and time-scale mismatches. (cf. §4.4; §4.3 cases).

We treat long-lived moral and philosophical warnings not as prescriptive doctrines but as *a form of anthropological survey data*: recurring, independent observations that certain incentive structures were repeatedly perceived as destabilizing. Their consistency across cultures gives them evidentiary weight, and our empirical analysis tests whether these historical perceptions correspond to measurable dynamics mappable to contemporary financial and ecological systems.

Warnings about *the corrupting force of wealth* recur across **human traditions of theo/philosophical thought**. In the Hebrew Bible, *Kohelet* observes that "whoever loves money never has enough" (*Kohelet* 5:9, Jewish Publication Society Tanakh, 1999/1985).

Christian sources echo this theme: "the love of money is a root of all kinds of evil" (*1 Timothy* 6:10, New International Version, 2011/1973).

The Qur'an similarly warns against hoarding, urging that wealth should circulate for the common good (*Qur'an* 9:34–35, Abdel Haleem, 2008).

Hindu philosophy in the *Bhagavad Gita* critiques attachment to material gain as a source of bondage (*Bhagavad Gita* 2:47, Easwaran, 2007)

The *Dhammapada* emphasizes nonattachment, teaching that clinging to wealth fosters suffering (*Dhammapada* 204, Buddharakkhita, 1985).

Parallel insights appear in **secular philosophy**. Confucius cautions in the *Analects* that the noble person is guided by righteousness, not profit (Confucius, 1999, 4.12).

Plato critiques oligarchy in *The Republic*, describing how the pursuit of wealth corrodes civic virtue and destabilizes the polis (Plato, 2007, Book VIII).

Adam Smith distinguishes productive wealth from mere accumulation, grounding value in real exchange (Smith, 2012).

Marx formalizes the drift toward money-for-money's-sake—M–M′—where accumulation detaches from material production (Marx, 1996/1867).

Contemporary literature and media echo these themes.

Arthur Miller's *Death of a Salesman* dramatizes the collapse of dignity under a success ethos defined by money (Miller, 2015).

Martin Scorsese's *The Wolf of Wall Street* satirizes finance-as-spectacle, where profit is harvested from manipulation and flows rather than real value creation (Scorsese, 2013).

Contemporary psychology reinforces these insights: materialism weakly predicts wellbeing, while nonattachment—secularly understood—improves mental health and reduces maladaptive clinging to wealth and status (Sahdra & Shaver, 2013; Sys, Van Gordon, & Gilbert, 2024).

Considered as a whole, these diverse voices—religious, philosophical, literary, cinematic, and empirical—illustrate a commonly perceived human recognition: *when money ceases to serve human needs and instead becomes an end in itself, it risks distorting both individual character and collective order.*

Table 16 - Comparative Table of Cross-Cultural Warnings on Wealth

Tradition / Domain	**Source**	**Key Warning about Wealth**	**APA Citation**
Jewish (Tanakh)	*Kohelet* 5:9	Love of money is insatiable	(Jewish Publication Society, 1999/1985)
Christian (NT)	*1 Timothy* 6:10	Love of money as root of evils	(New International Version, 2011/1973)
Islamic	*Qur'an* 9:34–35	Hoarding wealth invites punishment	(Abdel Haleem, 2008)
Hindu	*Bhagavad Gita* 2:47	Attachment to fruits of action binds	(Easwaran, 2007)
Buddhist	*Dhammapada* 204	Contentment is true wealth	(Buddharakkhita, 1985)
Chinese philosophy	Confucius, *Analects* 4.12	Noble person guided by righteousness, not profit	(Confucius, 1999)
Greek philosophy	Plato, *Republic* VIII	Oligarchy corrodes virtue through wealth pursuit	(Plato, 2007)
Political economy	Smith, *Wealth of Nations*	Value in production, not accumulation	(Smith, 2012)
Political economy	Marx, *Das Kapital*	M–M′: money accumulation detached from production	(Marx, 1996/1867)
Modern literature	Miller, *Death of a Salesman*	Success ethos reduces dignity to money	(Miller, 2015)
Film	Scorsese, *The Wolf of Wall Street*	Finance spectacle monetizes flows, not value	(Scorsese, 2013)
Psychology	Sahdra & Shaver (2013)	Nonattachment reduces maladaptive materialism	(Sahdra & Shaver, 2013)
Psychology	Sys et al. (2024)	Nonattachment improves wellbeing	(Sys et al., 2024)

4.1 Rationale:

- **Anthropological continuity:**

  When the same concerns about money, usury, speculation, or imbalance appear in cultures separated by time, geography, and institution, that recurrence itself is empirical evidence. It signals that humans repeatedly perceive and problematize similar dynamics.

- **Cross-cultural triangulation:**

  Religious texts, moral philosophy, and ethnography function as independent "samples" from different civilizations. Taken together, they provide a comparative dataset of enduring human intuitions about economic risk and value.

- **Historical salience:**

The longevity of these themes (centuries to millennia) suggests that they are not idiosyncratic outbursts, but stable signals of perceived tension between symbols (money, contracts) and substances (food, care, ecological renewal).

4.2 Emergent Patterns:

4.2.1. Recurrent Warnings Against Excessive Attachment to Wealth

- **Religious texts** (Jewish, Christian, Islamic, Hindu, Buddhist) converge on the observation that wealth becomes corrosive when it is hoarded or loved for its own sake. The recurring warning is that money's gravitational pull can never be satisfied ("whoever loves money never has enough" – Kohelet).

- **Philosophy** echoes this: Confucius, Plato, and later Smith and Marx all distinguish between the functional role of money in sustaining civic order or productive exchange versus its corrupting role when accumulation becomes the sole goal.

- **Modern psychology** reframes this in secular terms: materialism weakly predicts wellbeing, whereas detachment improves it.

- **Theme:** Across domains, **the danger is not wealth itself but the transformation of means into ends** — when money ceases to serve life and instead rules it.

4.2.2. Money as Distorter of Human Character and Social Order

- **Moral and philosophical sources** often stress the impact on character: greed corrodes virtue (Plato), nonattachment preserves dignity (Dhammapada, Bhagavad Gita).

- **Literary and cinematic depictions** (Death of a Salesman, The Wolf of Wall Street) dramatize how money-centric ethos hollows out dignity or civic responsibility.

- **Theme:** Money-centered pursuits are perceived to **erode both individual flourishing (character, wellbeing) and collective flourishing (justice, civic order).**

4.2.3. Separation of Symbol from Substance

- **Political economy** makes this explicit: Smith distinguished productive value from accumulation; Marx formalized the drift to M–M′ (money breeding money).

- **Contemporary finance** examples (derivatives, high-frequency trading, crypto tokens) embody this drift, where returns are harvested in symbol-space rather than tied to provisioning or repair.

- **Theme:** This is a **universal recognition of symbolic drift**—when abstract tokens lose tether to real goods, services, and ecological limits, dysfunction emerges.

4.2.4. Cross-Cultural Convergence and Anthropological Significance

- What's striking is not one isolated voice but the **independent recurrence across traditions**—religious, secular, artistic, and scientific.
- By appearing in such different cultural registers (scripture, philosophy, literature, psychology), these warnings act like **survey data across centuries**: repeated independent samples showing humans consistently perceive dangers in certain incentive structures.
- **Theme:** This convergence itself gives evidentiary weight. It allows you to treat moral framings as more than rhetoric — they are *anthropological constants* that flag persistent vulnerabilities in how humans handle wealth.

4.2.5. Continuity with Empirical Inquiry

- We consider these warnings are not conclusions but hypotheses. They establish why it is rational to test empirically whether today's systems (finance, healthcare, carbon markets) reproduce the very distortions humans have long feared.
- Moral framings provide **problem-identification and hypothesis-generation**, informing empirical work to provide the **testing and refinement**.

This convergence underscores why it is rational—not rhetorical—to begin with moral framings: they flag historically persistent vulnerabilities in incentive structures, which our empirical analysis then tests in contemporary markets and institutions.

4.3 NiCE reading

NiCE analyzes individual and systemic imbalances that reliably generate **toxic stress** when monetary signals decouple from biological, psychological, and institutional constraints.

4.3.1 Nature (N)

Claim. Biological and energetic limits are finite; when prices ignore them, extraction and chronic stress follow.

Evidence & analogues.

Planetary boundaries breached.

Humanity has transgressed **six of nine** Earth-system boundaries, indicating aggregate activity overshooting biophysical limits (e.g., climate, biosphere integrity, novel entities; Richardson et al., 2023).

No real decoupling.

With consumption-based accounting, national **material footprints** rise ~6% for every 10% GDP increase; absolute decoupling is rare (Wiedmann et al., 2015).

Policy-mispriced energy risk.

Fossil-fuel **underpricing** (explicit + implicit) totaled about **$7 trillion** in 2022 (~7.1% of global GDP), incentivizing over-use and off-loading health/climate damages (Black et al., 2023).

Resource collapses.

The Newfoundland **cod** moratorium (1992) remains a canonical case of market-driven overexploitation of a renewable resource (Hutchings & Myers, 1994).

Water depletion.

The **High Plains/Ogallala** aquifer is being pumped much faster than recharge; projections show sharp production declines without curbs—a slow-moving "Day Zero" (Steward et al., 2013).

Stress mechanisms.

Prolonged ecological/economic insecurity loads the stress system; sustained adversity links to "**toxic stress**" and later disease (Shonkoff & Garner, 2012).

Interpretive lens.

"Whoever loves money never has enough" (Ecclesiastes 5:10) captures the trap of unbounded accumulation—convergent with ecological-economics findings above (Jewish Publication Society, 1999/1985).

4.3.2 Consciousness (C)

Claim. When **profit** becomes a self-referential status signal, attention narrows to price movements, crowding out meaning, belonging, and stewardship.

Evidence & analogues.

Materialism ↘ well-being.

A meta-analysis of **259 samples** shows materialistic values correlate with **lower well-being** ($r \approx -.19$ to $-.24$); interventions that reduce materialism tend to improve well-being (Dittmar et al., 2014).

Materialism ↘ pro-environmental action.

Stronger materialistic values predict **lower** pro-environmental attitudes/behaviors and **higher** energy use (Gu et al., 2020; Isham et al., 2022).

Speculation and strain.

Hyper-financialized attention (e.g., retail day-trading) is associated with **overtrading losses** consistent with overconfidence/reward-seeking—an empirical analogue of attentional capture by prices (Barber & Odean, 2000).

Economic insecurity ↗ mental-health burden.

> Systematic reviews and longitudinal evidence link unsecured **debt/financial stress** to higher odds of **depression, anxiety, and suicidality** (Chen et al., 2024; Richardson et al., 2013).

Cross-tradition critiques.

Confucius: the **junzi** "comprehends according to right; the small man according to **profit**" (Analects 4.12/4.16; Confucius, 2003). Plato: **oligarchy** degrades civic virtue in favor of wealth (Plato, 2007). Marx: the drift from **M–C–M′** to **M–M′** makes money an end in itself (Marx, 1990/1867). These classics anticipate patterns now legible in the materialism and speculation literatures.

Cultural analogues.

Death of a Salesman (Miller, 2015/1949) and *The Wolf of Wall Street* (Scorsese, 2013) dramatize identity consumed by money/status.

4.3.3 Environment (E)

Claim. When institutions reward financial returns **untethered** from real goods/services, incentives tilt toward extraction in the symbolic layer (financial claims) rather than value creation in the material one.

Evidence & analogues.

Overuse externalized.

> Fossil-fuel underpricing sustains rent-seeking and delays transition (Black et al., 2023), while planetary-boundary transgressions and material-footprint trends show mounting extraction pressure (Richardson et al., 2023; Wiedmann et al., 2015).

Materialism & sustainability conflict.

> Reviews and cross-national work document consistent **negative** links between materialistic values and sustainable behavior (Gu et al., 2020; Isham et al., 2022).

Supply-side collapse cases.

> The cod fishery and Ogallala depletion exemplify policy/financial signals that ignore renewal rates, degrading natural capital and propagating social stress via income shocks and job loss (Hutchings & Myers, 1994; Steward et al., 2013).

Cross-tradition alignment.

Qur'an 9:34–35 warns against hoarded wealth (Abdel Haleem, 2008); the *Bhagavad Gita* (2:47) counsels **non-attachment** to fruits of action (Easwaran, 2007); the *Dhammapada* (v. 204) praises **contentment** (Buddharakkhita, 1985). Contemporary psychology converges: **nonattachment** relates to higher well-being and prosocial orientation (Sahdra et al., 2010).

Summary: NiCE shows how decoupled monetary signals drive predictable **stress-generating loops**: breaching biophysical limits (N), narrowing attention/meaning (C), and entrenching institutional incentives that externalize costs (E).

Table 17 - Matrix of Human Warnings on Wealth and Monetary Drift

NiCE Axis	Tradition / Domain	Source	Key Warning about Wealth	APA Citation
Nature (N)	Jewish	*Tanakh Kohelet* 5:9	Love of money is insatiable, masking ecological/biological limits	(Jewish Publication Society, 1999/1985)
Nature (N)	Christian	*Bible 1 Timothy* 6:10	Love of money as root of evils, destabilizing life's ground	(New International Version, 2011/1973)
Nature (N)	Islamic	*Qur'an* 9:34–35	Hoarding wealth invites decay and punishment	(Abdel Haleem, 2008)
Nature (N)	Buddhist	*Dhammapada* 204	Contentment is true wealth; craving breeds suffering	(Buddharakkhita, 1985)
Consciousness (C)	Hindu	*Bhagavad Gita* 2:47	Attachment to fruits of action binds consciousness	(Easwaran, 2007)
Consciousness (C)	Confucian	*Analects* 4.12	Noble person guided by righteousness, not profit	(Confucius, 1999)
Consciousness (C)	Greek philosophy	Plato, *Republic* VIII	Oligarchy corrodes virtue through wealth pursuit	(Plato, 2007)
Consciousness (C)	Political economy	Marx, *Das Kapital*	M–M′: money accumulation detached from production	(Marx, 1996/1867)
Consciousness (C)	Modern literature	Miller, *Death of a Salesman*	Success ethos reduces dignity to money	(Miller, 2015)

NiCE Axis	Tradition / Domain	Source	Key Warning about Wealth	APA Citation
Consciousness (C)	Film	Scorsese, *The Wolf of Wall Street*	Finance spectacle consumes attention, monetizes illusion	(Scorsese, 2013)
Environment (E)	Political economy	Smith, *Wealth of Nations*	Value grounded in production/exchange, not speculation	(Smith, 2012)
Environment (E)	Psychology	Sahdra & Shaver (2013)	Nonattachment reduces maladaptive materialism	(Sahdra & Shaver, 2013)
Environment (E)	Psychology	Sys, Van Gordon, & Gilbert (2024)	Nonattachment improves wellbeing and prosociality	(Sys et al., 2024)

As monetary systems become more abstract—from electronic clearing to complex derivatives and digital currencies—the distance between financial symbols and the real resources they purport to represent grows. By any coherent metric, the implications are clear. Profits are increasingly harvested within the monetary sphere itself, detached from the creation of goods, services, or social value.

The rift is widest when money is traded as a commodity, insulated from ecological constraints, so price tracks momentum and demand rather than any underlying biophysical substrate. This drift, observed across millennia of human reflection, is not merely a technical flaw but a strong and recurring anthropological cautionary tale: when symbols of value eclipse their ecological ground, both sanity and sustainability are imperiled.

As monetary systems become more abstract—from electronic clearing to complex derivatives and digital currencies—the distance between financial symbols and the real resources they purport to represent grows. By any coherent metric, the implications are clear. Profits are increasingly harvested within the monetary sphere itself, detached from the creation of goods, services, or social value. The rift is widest when money is traded as a commodity, insulated from ecological constraints, so price tracks momentum and demand rather than any underlying biophysical substrate.

4.4 Case Study Examples:

4.4.1 Derivatives and the 2008 Financial Crisis

Example: Mortgage-backed securities and credit default swaps were traded and re-traded as if they were commodities in themselves, with profits extracted entirely within the financial sphere. The underlying mortgages (the “substrate”) became almost irrelevant (Stout, 2011).

4.4.2 Cryptocurrencies and Speculative Tokens

Bitcoin and other digital currencies are often valued not for their utility as mediums of exchange but for speculative demand. Their price reflects momentum and scarcity narratives rather than any tether to ecological or productive value (Baur, Hong, & Lee, 2018).

4.4.3 High-Frequency Trading (HFT)

Algorithmic traders' profit from microsecond discrepancies in price quotes. These profits are harvested entirely within the symbolic layer of markets, without any connection to goods, services, or ecological resources (Aldridge 2013).

4.4.4 Ecological Disconnect

Carbon credits and emissions trading can become detached from actual reductions in greenhouse gases when they are bundled, securitized, and speculated upon. The financial instrument circulates independently of the ecological substrate it was meant to represent (Lohmann, 2009).

4.5 Conceptual Framing

This is precisely what Marx described as the shift from **M–C–M′** (money → commodity → more money) to **M–M′** (money → more money). The commodity step — the tether to real production — is bypassed (Marx 1976).

4.5.1 Electronic market microstructure: extracting rents from *speed* and order flow

Latency/queue arbitrage in continuous limit order books.

Academic market-design work shows that today's microsecond-race confers mechanical arbitrage rents to the fastest traders (a "socially wasteful arms race"), which can be eliminated by batch auctions; the profits arise from timing frictions, not new production (Budish, Cramton, & Shim, 2015).

2010 "Flash Crash" fragility.

The joint CFTC–SEC staff report traced how algorithmic trading and stressed liquidity cascaded into an extreme, minutes-long price spiral—illustrating how symbol-space dynamics can decouple briefly from fundamentals (U.S. Commodity Futures Trading Commission [CFTC] & U.S. Securities and Exchange Commission [SEC], 2010).

Payment for order flow (PFOF).

The SEC's 2020 action against Robinhood documented how routing retail orders for rebates produced inferior execution for customers—brokers profiting from order-routing economics rather than investment value creation (U.S. Securities and Exchange Commission [SEC], 2020).

4.5.2 Derivatives engineering: creating/repackaging exposures untethered to new assets

Synthetic CDOs (ABACUS 2007-AC1).

SEC filings detail how a CDO was structured so a short investor could profit if mortgages failed; the long/short payoffs were created entirely within derivatives—no new housing or productive asset resulted (U.S. Securities and Exchange Commission [SEC], 2010a).

Total-return swaps and hidden leverage (Archegos).

The SEC's 2022 complaint explains how TRS allowed massive, opaque equity exposure without ownership or disclosure—amplifying purely financial gains/losses that later spilled onto banks' balance sheets (SEC, 2022).

Scale of abstraction.

BIS statistics show notional OTC derivatives in the $600–700+ trillion range—orders of magnitude above global GDP—underscoring how large the claims-space is versus the physical economy (Bank for International Settlements [BIS], 2024).

4.5.3 Financialization of commodities: prices co-moving with index flows

Index investment effects.

Peer-reviewed evidence links the 2000s surge in commodity-index investment to stronger cross-commodity correlations—pricing increasingly following financial index flows rather than isolated supply–demand fundamentals (Tang & Xiong, 2012).

4.5.4 Crypto & DeFi: returns from token mechanics, leverage, and flows

Structural critique of DeFi.

BIS reports conclude that much of crypto/DeFi replicates traditional finance, often with de-facto centralization and growth driven by speculative inflows, while largely not financing real-economy activity (Aramonte, Huang, & Schrimpf, 2021).

Algorithmic-stablecoin collapse (Terra/UST, 2022).

The rapid death-spiral demonstrated how "yield farming" and reflexive arbitrage pegs can vaporize when confidence breaks—value was being recycled inside the token complex rather than anchored to productive assets (Congressional Research Service [CRS], 2022).

Policy stance.

Recent BIS chapters warn that stablecoins lack the settlement integrity of central-bank money and can transmit stress; the proposed remedy is tokenized platforms anchored in central-bank reserves (Arner, Auer, & Frost, 2020).

4.5.5 Systemic context: non-bank leverage as amplifier

This section expands the Human Paradigm framework by showing how irrational monetary logic (profit/price motive) short-circuits what is truly valuable across multiple domains, including evolved human survival instinct, and demonstrates these dynamics through a focused case study on human incentives within the NiCE framework microscope.

NBFI (shadow-bank) leverage. FSB progress reports flag recurring liquidity stresses from leveraged non-banks (e.g., margin spirals, basis trades), where balance-sheet gains are financial in nature yet can transmit real-economy harm when they unwind (Financial Stability Board [FSB], 2025).

4.5.6 Conceptual Framing: Use-Value vs. Exchange-Value

Use-value:

Goods/services with intrinsic survival value (nutrition, shelter, water, social bonds).

Exchange-value:

Symbolic proxies (money, credit, derivatives) with no inherent survival function.

Whereas other species transact more directly in use-value (e.g., food for grooming, sex as a natural drive for reproduction), humans alone trust in **zero-use-value symbols**, *creating a unique evolutionary paradox: abstraction enabled planetary-scale coordination, but also seeded collective irrationality when symbols drifted from* **ecological reality** (Graeber 2011).

Unlike commodities possessing direct intrinsic use-value for survival—the humble sandwich for example, having the value to directly sustain one person's nutritional needs for a day or more—money possesses no immediate direct survival-serving benefit.

A sandwich intrinsically contains a limiting incentive structure: its shelf life is short, its utility is bounded, and excessive hoarding leads only to waste and disposal problems imposing natural toxic stress on the misguided hoarder. These tensions naturally act as constraints on greed and as well as reason and encourage distribution to others in need, often at reduced or even *no* price, as preferable rather than allowing food to spoil unused.

Money, by contrast, lacks any such natural constraint or intrinsic incentive more than simply 'not getting caught' to stave off abuse. Its only inherent tension is its tendency to lose value over time through rationalized "inflation." Instead of naturally encouraging redistribution when in excess, money generates perverse incentive: *to accumulate forever*, precisely to offset its inevitable gradual devaluation, or in symbolic value terms – as *deflation*.

When accumulation crosses a threshold, money shifts in symbolic meaning. No longer a measure of sustenance or security, it becomes a token of irrational power. In this transformation, the natural strength of youth in a rational economy is usurped by the calculated schemes of a few aging elites (Allison & The Who, 1970). This is the root of its toxic stress: money's allure detaches from meeting human needs and instead fuels disproportionate, unwarranted control over others. It is difficult to identify any other human invention that has driven such relentless accumulation or so inflamed the collective psyche. Voices arguing to the contrary appear to have one thing in common: they have something to gain in the short term by defending it, and something to lose should systems undergo reform.

Opposition to systemic reform is rarely disinterested. Across disciplines, research shows that resistance tends to cluster among those with concentrated short-term advantages under the status quo, and with corresponding losses to fear should change occur.

Political economy identifies this as **status quo bias**, where entrenched actors defend existing arrangements because their benefits are immediate and visible, while the gains of reform are diffuse and uncertain (Fernandez & Rodrik, 1991).

Psychology frames it as **system justification**, a motivation to rationalize and defend prevailing structures even when they perpetuate inequality, because doing so reduces uncertainty and preserves advantage (Jost et al., 2017).

Behavioral economics documents similar inertia in financial decision-making, where individuals cling to existing allocations despite inefficiency, especially when vested interests are at stake (Lippi et al., 2022).

Systems theory underscores that entrenched actors resist change precisely because their **resources, legitimacy, and symbolic capital** are tied to the very structures under threat (Foster-Fishman & Watson, 2017). Taken together, these perspectives reinforce the observation that voices raised against reform are often those with the most to lose from its success.

4.6 Causal Pathways of Symbolic Drift

4.6.1 Monetary expansion → credit and liquidity increase perceived abundance.

Central bank monetary expansion (e.g., quantitative easing) increases liquidity, which can create a perception of abundance and stability even when underlying productivity is stagnant. This "wealth effect" is symbolic rather than material (Borio & Disyatat 2010).

4.6.2 Mispricing of ecological scarcity → resource depletion signals are masked.

Market prices often fail to internalize ecological scarcity (e.g., undervaluing water, soil fertility, or carbon sinks). This masks depletion signals, encouraging overuse (Daly & Farley 2011).

4.6.3 Behavioral response → consumption, reproduction, and investment overshoot natural limits.

When scarcity signals are muted, households, firms, and states overshoot ecological carrying capacity, reinforcing growth-oriented behaviors that exceed planetary boundaries (Rockström, Steffen, Noone, Persson, Chapin, Lambin, & Foley 2009).

4.6.4 Environmental degradation → soils, water, biodiversity, and climate systems decline.

Overshoot manifests as measurable degradation of ecosystems, including soil erosion, freshwater depletion, biodiversity collapse, and climate destabilization (Intergovernmental Panel on Climate Change (IPCC) 2022).

4.6.5 Recursive loop → environmental damage increases reliance on monetary expansion to sustain appearances of prosperity.

> As ecological decline undermines real productivity, states and markets increasingly rely on monetary expansion and financial engineering to maintain the illusion of prosperity, deepening the cycle (Stern, 2007).

Thus, money short-circuits natural feedbacks, degrading both consciousness (C) and environment (E) simultaneously (Standing 2011).

4.6.1 The Tempo Paradox

- **Too fast:** Monetary shocks (hyperinflation, credit collapse) overwhelm N and C, triggering panic and acute distress.
- **Too slow:** Gradual mispricing (cheap fossil fuels, underpriced water) habituates society to drift, tolerating collapse by stealth.
- **Goldilocks alignment:** Resource-indexed pricing with cadenced adjustments (annual carbon price escalators, seasonal water tariffs) preserves salience without overload (OECD 2018).

4.6.2 Twelve Mechanisms of Incentive Misalignment (evidence summaries)

1. **Healthcare commodification**

In the United States, healthcare is structured primarily as a for-profit enterprise, unlike most other high-income nations. Administrative overhead and insurer margins drive spending to nearly twice the OECD average, while health outcomes rank comparatively low (Himmelstein 2016; Tikkanen 2020).

The monetary signal prioritizes profitability over patient well-being, leading to hospital closures in low-income regions and rationed access to essential services. This dynamic illustrates how monetary logic short-circuits the intrinsic value of health itself.

2. **Pharmaceutical profiteering**

Essential medicines such as insulin have been trapped in monopolistic pricing regimes that bear little relationship to production costs. In the U.S., patients often pay hundreds of dollars monthly for a century-old therapy, with preventable morbidity and mortality resulting from rationing (Greene 2015). Here, the price system privileges patent rents over human survival, a direct inversion of true value.

3. **Dietary degradation**

Industrial food systems, guided by profit maximization, have optimized products for shelf life and consumer "bliss points" (salt, sugar, fat) rather than nutrition. The result is cheap calorie abundance coupled with micronutrient poverty, especially in low-income communities (Swinburn 2019). This monetary drift converts sustenance into a commodity that undermines the very health it purports to sustain.

4. Obesity pandemic

The global rise in obesity and metabolic disease exemplifies the externalization of health costs. Ultra-processed foods are systematically cheaper per calorie than fresh produce, pushing populations toward diets linked with diabetes, cardiovascular disease, and shortened lifespans (Moodie 2013). Profit incentives drive an epidemic of consumption while degrading the ecological and biological bases of well-being.

5. Environmental externalities

Markets routinely ignore ecological damages such as carbon emissions, soil erosion, and biodiversity loss. Without pricing these externalities, money signals encourage overuse and exploitation of finite resources (Stern 2007). This divorces exchange value from ecological reality, embedding collapse risks directly into economic growth.

6. Planned obsolescence

From smartphones to household appliances, many products are intentionally designed for premature failure or rapid fashion turnover. This practice maximizes sales but wastes material, energy, and labor, accelerating ecological degradation (Cooper 2016). In this case, monetary logic subordinates durability—a true value—to cycles of disposability.

7. Education debt trap

Higher education increasingly functions as a revenue-maximizing industry, with tuition inflation outpacing wages and student debt reaching unprecedented levels. Instead of expanding knowledge as a public good, education is recast as a financial liability for households (Marginson 2016). Here, monetary signals corrode the intrinsic value of learning and human development.

8. Housing speculation

Homes are treated as financial assets as a mechanic to 'build and accumulate wealth' rather than shelters, with speculative capital inflows inflating prices in global cities. These mechanics produce homelessness, dislocation, and inequality while rewarding investors (Fields 2018). Monetary signals thus displace the true value of housing—safety and stability—with asset appreciation.

9. Labor alienation

Precarious employment, gig work, and profit-driven restructuring channel labor into maximizing shareholder returns rather than supporting human flourishing. Workers face burnout, insecurity, and disconnection from meaningful activity (Standing 2011). In this context, money becomes both the carrot and whip, reducing life energy to abstracted wage signals.

10. Cultural commodification

Art, music, and literature are increasingly evaluated by commercial potential rather than expressive, communal, or transcendent value. Global entertainment conglomerates emphasize profitability, shaping culture through market algorithms (Hesmondhalgh 2013). The creative impulse—once intrinsic—is short-circuited by monetary logics of ratings and sales.

11. Biodiversity monetization

"Natural capital" accounting and biodiversity offsets turn ecosystems into tradable units rather than living communities. While sometimes framed as conservation, such schemes often facilitate further extraction and habitat loss (Sullivan 2017). In this way, money abstracts away the true ecological value of biodiversity into exchangeable credits.

12. Debt servitude

Households and nations increasingly devote resources to servicing debt, diverting funds from health, education, or ecological regeneration. This creates cycles of dependency and austerity that undermine resilience (Graeber 2011). Debt, once a social relation, becomes a mechanism of monetary domination that erodes true human value.

4.6.3 Ten Drifted Pharmaceutical Incentives

1. **Underinvestment in antibiotics**

   Because antibiotics are used briefly and stewardship limits sales, companies face poor revenue prospects. As OECD and WHO note, the pipeline of new antibiotics remains dangerously thin, despite rising resistance to existing ones (OECD 2018; WHO 2020). The monetary signal punishes life-saving cures, privileging profitability over survival.

2. **Pay-for-delay settlements**

   Brand-name pharmaceutical firms have repeatedly paid generic manufacturers to delay market entry. The U.S. FTC estimates these deals cost consumers billions annually in higher drug spending (FTC 2010). Here, profit protection outweighs patient access, showing how monetary incentives distort innovation timelines.

3. **Patent evergreening**

   Firms routinely extend monopolies through secondary patents on formulations, dosing regimens, or delivery systems, even without major therapeutic improvement. Empirical analyses show this practice systematically delays generic competition (Kapczynski 2012). Monetary logic rewards enclosure of knowledge rather than genuine therapeutic advancement.

4. **High prices restricting Hepatitis C cures**

   Direct-acting antivirals cure >90% of Hepatitis C patients, but initial U.S. launch prices ($100,000+) forced insurers to ration treatment to only the sickest (Chhatwal 2015; Barua 2015). A therapy with immense intrinsic value was constrained by the monetary calculus of affordability.

5. **Cancer drugs with modest gains**

Many oncology drugs deliver median survival benefits measured in weeks or months, yet are priced at $100,000+ annually (Fojo2009; Gyawali2020). Profit signals reward market entry more than therapeutic impact, short-circuiting the true value of life extension.

6. **Marginal value of new drugs**

   Systematic reviews in Germany and elsewhere show that most newly approved drugs offer little or no improvement over existing therapies (Wieseler 2019). Yet premium launch prices persist, illustrating the disconnect between therapeutic value and monetary reward.

7. **Blockbuster chronic disease model**

   The pharmaceutical industry derives the bulk of revenue from “blockbuster” drugs for chronic diseases—statins, insulin analogues, arthritis biologics—taken for decades. These models generate predictable revenues far exceeding the profits from one-time curative therapies (Angell 2004). Here, structural incentives align against cures.

8. **Cost-sharing barriers**

   Even when effective therapies are approved, insurer cost-sharing requirements suppress uptake among patients. Studies show reduced adherence and worse outcomes when copayments are high (Dusetzina 2018). Monetary filtering mechanisms directly curtail access to cures, subordinating health to budget signals.

9. **Public funding dominance**

   Analyses of 2010–2016 approvals found NIH funding contributed to the foundational science of every new drug (Cleary2018). Private firms captured downstream rents through patents and pricing, despite public underwriting of risk. This inversion of value demonstrates how monetary signals reassign credit away from true contributors.

10. **Policy pilots correcting misaligned incentives**

    Governments now experiment with “pull” incentives—such as the UK subscription model for antibiotics—that pay firms based on societal value rather than unit sales (Outterson2016). These reforms implicitly recognize the structural bias of current monetary systems and attempt to realign money with true health value.

4.7 Money in Maslow’s hierarchy?

Bottom line: Money is **not itself a human need** in Maslow’s sense; it is a symbolic human construct as a *general-purpose resource* that while the fuzzy context to support it is maintainable, serves to help people satisfy multiple needs. It is most **constitutive** for *physiological* and *safety* needs, becomes **indirect/conditional** at *belonging* and *esteem*, and is usually **enabling** (not constitutive) for *self-actualization*. (Maslow, 1943; Hobfoll, 1989).

Money enables the pursuit of higher-level needs in human societies by converting symbolic value into access to material, social, and cognitive goods that once were

accessible directly through nature or community.
However, the cost of this symbolic mediation is that **money equalizes everything into a single metric**—forcing even *biological* or *natural* needs (food, water, shelter, safety) to compete on an abstract economic playing field rather than being directly fulfilled through ecological participation.

In short:

- In **nature**, *lower needs* (survival, security) are fulfilled through **direct reciprocity** and environmental embeddedness.
- In **monetized systems**, *lower needs* are fulfilled only through **symbolic exchange**—currency—while *higher needs* (esteem, self-actualization) become *easier* to access symbolically (visibility, identity, recognition).
- The result: **money artificially compresses the pyramid**, allowing pursuit of higher needs while bypassing—or externalizing—the lower ones.

4.7.1 NiCE Analysis

N — Nature (biophysical grounding)

In natural or pre-monetary contexts:

- Survival needs are satisfied through **direct ecological reciprocity** (foraging, community care, shared labor).
- Higher needs—belonging, esteem—emerge *after* this base is stably met.

Under monetary mediation:

- Access to *natural resources* becomes conditional on **exchange value**, not ecological presence.
- The market converts what was once free or communal (air, water, land, safety) into **priced commodities**.
- **Money thus removes "directness" from survival** and places both basic and higher needs within the same symbolic pricing field.

Effect: Money introduces **artificial scarcity** at the base (you must earn before you eat) while inflating the perceived accessibility of the top (you can "buy" status, belonging, esteem).

Empirical support:

- Anthropological studies of gift economies show that *belonging and reciprocity* were intrinsic to survival, not post-survival luxuries (Mauss, 1925/2002).
- Economic development correlates with **greater substitution of social capital with financial capital**, increasing loneliness and stress even when material conditions improve (Putnam, 2000).

- Financialization of basic needs (housing, healthcare, education) correlates with reduced subjective security (Layard et al., 2023).

C — Consciousness (motives and perception)

- Money is a **secondary reinforcer** that hijacks primary reward circuitry (Lea & Webley, 2006; Sescousse et al., 2013).
- Because it can *represent* any need, the brain learns to treat money as the universal shortcut to all satisfaction.
- This leads to a **flattening of motivational hierarchy**: money becomes both *the means* and *the perceived end*.
- Individuals then rationally—but maladaptively—pursue *symbolic sufficiency* (wealth, visibility, esteem) even while *physiological deficits persist* (e.g., work-induced sleep loss, malnutrition, burnout).
- Enables consumerism, and pathologies at edges, and at some level across the board.

Money-related pathologies

- **Materialism** — privileging possessions and wealth as central to identity and well-being, associated with lower life satisfaction and reduced prosociality (Dittmar et al., 2014).
- **Compulsive buying and addictive consumption** — recurrent, harmful purchasing behavior linked to money's role as a secondary reinforcer (Lea & Webley, 2006; Sescousse et al., 2013).
- **Status anxiety and social comparison** — chronic self-evaluation against material markers, increasing stress and social isolation (Putnam, 2000; Layard, 2011).
- **Debt stress and financial insecurity** — persistent psychological distress, depression, and poorer health outcomes among indebted households (Turunen & Hiilamo, 2014).
- **Hoarding and accumulation** — pathological accumulation of goods or money as anxiety management traceable to money's abstract reward properties (Lea & Webley, 2006).
- **Commodification of relations** — treating social bonds and communal obligations as tradable services, eroding reciprocity and social capital (Mauss, 1925/2016; Putnam, 2000).
- **Moral crowding-out** — extrinsic monetary incentives displacing intrinsic motives for cooperation, care, or civic behavior (Deci et al., 1999).
- **Corruption and rent-seeking** — institutional distortion where monetary gain overrides public interest and governance legitimacy (Philippon, 2015).
- **Metric fixation and instrumental reduction** — reducing complex human goods to monetary metrics, producing perverse incentives and policy misdirection (Muller, 2018).
- **Environmental externalization** — financial structures that monetize access while externalizing ecological costs, accelerating overshoot and degradation (Black et al., 2023).

- **Political capture and weakened legitimacy** — concentrated money translating into disproportionate influence and erosion of procedural justice (Putnam, 2000; Tyler, 2003).
- **Work-life pathology and burnout** — monetized incentives driving overwork, sleep loss, and embodied decline despite nominal material gains (Maslach et al., 2001; McEwen, 1998).

Effect: Consciousness becomes **rewired to overvalue abstraction** and **undervalue embodied well-being**.

E — Environment (institutions and payoff architecture)

- Modern systems design incentives around **monetary throughput**, not fulfillment throughput.
- This aligns with Goodhart's Law (Muller, 2018): *what's measured (money) becomes what's optimized*, regardless of whether it satisfies the underlying human or ecological need.
- Institutions reinforce this drift through policy (GDP, income growth) and organizational KPIs (revenue, visibility, engagement).

Effect: Systemic irrationality—**the economy grows even as life quality or stability degrades**.

Table 18 - Integrative Synthesis

Context	Path to lower-need fulfillment	Path to higher-need fulfillment	Money's effect
Natural/ecological	Direct interaction with environment; reciprocity; self-provision	Emerges from stable belonging, security	Sequential & embodied
Monetary system	Indirect access via exchange; monetized barriers to basics	Symbolically available through visibility, consumption, or esteem	Simultaneous but distorted
Outcome	Rational order (survival → self-actualization)	Compression and drift (self-actualization pursued while insecure)	Systemic misalignment

4.7.2 Is this "irrational"?

At the **individual level**, behavior looks irrational (people pursuing esteem while hungry, security while indebted).
At the **systemic level**, it is *rational under distorted incentives*: the system rewards symbolic alignment (money, metrics, visibility) over biophysical adequacy.

Thus, **Maslow's hierarchy hasn't failed; money has cognitively reframed and overridden it. We lose sight of what naturally serves our better interest over time as it drifts.**
The motivational inversion arises not from human error, but from **incentive architecture** that pays for abstraction.

Table 19 - NiCE-aligned reforms

NiCE Axis	Reform Principle	Implementation Example
Nature	Re-ground economic signals in biophysical throughput	Price ecological harms (Black et al., 2023); set absolute energy budgets (Richardson et al., 2023).
Consciousness	Reorient reward systems toward embodied well-being	Corporate wellness KPIs tied to sleep, nutrition, safety; remove "visibility" pay.
Environment	Design "repair-prioritized" incentives	Subsidize restorative basics (housing, healthcare) before symbolic capital (branding, PR).

System-level fix:
Re-anchor *value* in what sustains life (thermodynamic, ecological, and psychological reality), not what signals it.

Summary

Money's brilliance is also its flaw.
It democratizes the pursuit of higher needs by converting everything into a universal token—but in doing so, it **forces even survival into competition** within that same symbolic field.
The hierarchy doesn't disappear; it's *hacked*.
To restore rational order, **systems must reprice reality** so that survival is not a premium purchase, and symbolic advancement no longer undermines basic stability.

4.7.3 Physiological needs (food, sleep, shelter) → Money as constitutive access

- In monetized economies, income directly purchases nutrition, housing, heat, and medical care—so insufficient income undermines these base needs. Large global analyses show that fulfillment of *basic* needs is the strongest predictor of "life evaluation."

- Empirically, higher income is robustly associated with better life evaluation, and (depending on study) emotional well-being up to and beyond mid-income thresholds.

- Scarcity and debt consume cognitive bandwidth and degrade decision quality—mechanisms by which lack of money impairs basic functioning. Debt relief reverses part of this effect. (Mani et al., 2013; Ong, Theseira, & Ng, 2019).

Takeaway: For the bottom of the hierarchy, money is *instrumental but essential*.

4.7.4 Safety needs (security, stability) → Money as buffer & resource

- Money functions as a "**resource**" in the Conservation of Resources model—something people strive to acquire/retain to prevent stress from resource loss. (Hobfoll, 1989).

- Financial slack reduces chronic stress and risk-avoidant decision patterns; reducing the *number* of debt accounts improved cognition and anxiety independent of total dollars, highlighting how money's *structure* affects perceived safety. (Ong et al., 2019).

Takeaway: At safety, money primarily **buffers** against uncertainty and loss.

4.7.5 Belonging (love, affiliation)

Money is weak or ambivalent

- Belongingness is a fundamental human motive in its own right; having money doesn't secure it. (Baumeister & Leary, 1995).

- Studies suggest **local (face-to-face) status**—respect within one's group—matters more for well-being than socioeconomic status per se. (Anderson, Kraus, Galinsky, & Keltner, 2012).

- Priming "money" can *reduce* interpersonal warmth and helping (a self-sufficiency cue), implying a possible **trade-off** with affiliation. (Vohs, Mead, & Goode, 2006).

Takeaway: Money is **neither necessary nor sufficient** for belonging and can even **crowd it out**.

4.7.6 Esteem (competence, recognition) → Money as status signal, not essence

- Income can buy status symbols, but **sociometric status** (the respect you command among peers) predicts well-being more strongly than raw SES. (Anderson et al., 2012).
- Valuing **financial success as a central life goal** is often linked to lower well-being and less prosocial orientation. (Kasser & Ryan, 1993, 1996).

Takeaway: Money can **signal** esteem but does not **produce** it; competence and social respect are the active ingredients.

4.7.7 Self-actualization / growth → Money as enabler, with diminishing returns

- Once basic and safety needs are secure, **autonomy, competence, and relatedness** (Self-Determination Theory)—not money—drive sustained well-being and growth; contingent rewards can sometimes undermine intrinsic motivation. (Deci & Ryan, 2000; Deci, Koestner, & Ryan, 1999).

- Large-scale well-being data show nuanced income effects: early work suggested a plateau in emotional well-being (~US$75k), newer studies find **continued gains** on average, with heterogeneity (i.e., returns depend on the person/context). (Kahneman & Deaton, 2010; Killingsworth, 2021; Kahneman et al., 2023).

Takeaway: Money **enables** self-actualization by buying time, security, and options; the growth engine itself is **intrinsic** motivation and meaning.

4.7.8 Synthesis & guidance

- Treat money as a **cross-level facilitator**—not the target. Secure *enough* to stabilize **physiology/safety**, then design life and systems around **belonging, competence, autonomy, and meaning**. (Maslow, 1943; Tay & Diener, 2011; Deci & Ryan, 2000).

  Research on income and well-being reinforces the view that money is best understood as a facilitator rather than a target. Kahneman and Deaton (2010) famously identified a threshold of approximately **$75,000 per year (in 2008 U.S. dollars)**, beyond which additional income no longer improved **day-to-day emotional well-being**, though it continued to raise **life evaluation** (cognitive judgments about one's life). Importantly, this figure was **not a universal or "magic" number**; it reflected the U.S. economic context at the time of study. The authors themselves emphasized that the relevant threshold would **scale with inflation and local cost of living** in order to secure the same sense of stability and relief from stress.[1]

  More recent work complicates and extends these findings. Killingsworth, Kahneman, and Mellers (2023) found that for most people, happiness continues to rise with income well beyond $75,000, even up to $500,000. However, for a less happy minority, the plateau effect remains, with emotional well-being leveling off around $100,000. Taken together, these studies suggest that while money is crucial for meeting **basic physiological and safety needs** (Maslow, 1943) and for enabling higher-order pursuits of **belonging, competence, autonomy, and meaning** (Deci & Ryan, 2000; Tay & Diener, 2011), its marginal utility diminishes once sufficiency is achieved. Beyond that point, well-being depends less on income and more on psychosocial and existential factors.

  [1] *$75,000 in 2008 is roughly equivalent to about $105,000 in 2025 dollars, adjusted for U.S. inflation. The threshold should therefore be understood as a* ***relative benchmark of sufficiency****, not an absolute figure.*

- When diagnosing systemic or individual problems, it is critical to account for the cognitive and psychological effects of financial scarcity. Mani et al. (2013) demonstrated that scarcity itself imposes a **"bandwidth tax"**: when individuals are preoccupied with financial strain, their cognitive capacity is measurably reduced, impairing decision-making and problem-solving.

Ong, Theseira, and Ng (2019) extended this insight by showing that **debt structure matters as much as debt magnitude**. In their quasi-experimental study of a debt-relief program, eliminating multiple small debt accounts improved cognitive functioning and reduced anxiety more than equivalent relief applied to a single large account.

This suggests that interventions should be **targeted at the right level**: debt consolidation or relief can restore safety and reduce stress; community and recognition can address belonging and esteem; and autonomy-supportive design can foster growth and intrinsic motivation (Anderson & Butcher, 2007; Deci & Ryan, 2000).

In short, effective remedies must align with the **psychological layer of need being disrupted**, rather than assuming that financial inputs alone will suffice.

- Maslow's hierarchy remains a *useful heuristic*, but it cannot be treated as a rigid staircase as money increasingly abstracts real value over time and overrides it. Early reviews agree finding limited empirical support for a strict rational sequential hierarchy. Wahba and Bridwell (1976), in a comprehensive review of need hierarchy research, concluded that the evidence did not support the idea that lower needs must be fully satisfied before higher needs become motivational. More recent cross-cultural work confirms that **needs operate in parallel** as money compresses the natural hierarchy.

  Tay and Diener (2011), analyzing data from over 60 countries, found that people report fulfillment of multiple needs simultaneously, and that higher-order needs (e.g., social connection, respect, autonomy) contribute to well-being even when lower-order needs are not fully met. This suggests that while Maslow's framework provides a **conceptually elegant map**, modern evidence supports a more **irrationally dynamic, overlapping model of human motivation** that is sensitive to cultural and contextual variation that arise in the environment where money is rationalized as a legitimate resource on the same plane as real needs.

4.8 Monetary Signals, Demographic Dynamics, and Ecological Overshoot

Thesis. When monetary signals drift away from biophysical reality, well-meant policies (including pronatal or growth-first incentives rewired as drift) can amplify ecological overshoot. Sound design aligns prices and incentives with biocapacity while acknowledging population momentum and the unequal, consumption-driven nature of impacts.

4.8.1 Start from ecological reality, not symbols.

Multiple lines of evidence show the human economy already exceeds planetary regenerative capacity (ecological overshoot) and appropriates growing shares of water and energy stocks (Wackernagel et al., 2002; Mekonnen & Hoekstra, 2016). Ecological footprinting and global water-scarcity mapping make clear that sheer throughput—not accounting conventions—sets the binding constraints.

4.8.2 Demography matters—but mostly through momentum and interaction with affluence/technology.

Classic results in formal demography show that even a rapid fall to replacement fertility leaves decades of population growth because of age-structure inertia (Keyfitz, 1971). Contemporary scenario work estimates that demographic change alone explains a meaningful but partial share of 2050 CO_2 reductions ($\approx 16 - 29\%$) compared with technology/affluence levers (O'Neill et al., 2010). Policy should therefore avoid magical thinking about quick demographic fixes and instead pair family well-being with demand- and technology-side decarbonization.

4.8.3 The distributional engine of impact is affluence-linked consumption.

Cross-national input–output studies attribute a disproportionate share of emissions to high-expenditure households and countries; "affluence" (consumption volume) is a dominant driver (Wiedmann et al., 2020; Ivanova & Wood, 2020). Interventions must therefore target high-impact consumption domains (e.g., energy, mobility, aviation) along with technology intensity.

4.8.4 Align money with matter: price externalities, index to resources, and avoid lock-in.

Empirical evaluations of broad-based carbon pricing find significant emissions reductions with neutral to slightly positive macroeconomic effects (Metcalf & Stock, 2023; Murray & Rivers, 2015). Complement pricing with policies that prevent long-lived infrastructure from "locking in" future emissions (Davis et al., 2010; Seto et al., 2016). Together these reduce the symbol–substrate gap between monetary signals and biophysical flows.

4.8.5 Family policy: design for household security without increasing throughput.

Housing and wealth conditions shape fertility differently for owners vs. renters: rising house prices raise births among owners (via equity) while lowering them for non-owners (Dettling & Kearney, 2014), with similar patterns in Denmark (Daysal et al., 2020). "Pro-family" packages that improve security (childcare, income stability, housing access) can be ethically justified—yet should be paired with strict resource-side constraints (clean energy, pricing, caps) so added security does not translate into higher material throughput.

4.8.6 NiCE Framed Systems Design Implications

Designing resilient monetary-ecological systems requires aligning incentives with **real resources** rather than symbolic drift. The NiCE framework highlights three interdependent layers:

Nature (N):

> Biological and energetic limits are finite. Incentives must respect these boundaries by tying monetary flows to physical throughput. Resource-indexed transfers (e.g., dividends funded by carbon or energy rents) and outcome-based contracts (e.g., efficiency gains, demand reduction) ensure that "winning" requires congruously balancing natural tensions optimally wherein humans best thrive and reducing material stress, not merely moving money. This addresses the **pace paradox**: financial systems accelerate abstraction, but ecological systems operate on slower

renewal cycles. Incentives must therefore slow symbolic churn to the tempo of natural regeneration and absorption.

Consciousness (C):

When profit becomes a self-referential signal, attention narrows to price movements, crowding out meaning, belonging, and stewardship. Empirical research on income and wellbeing reinforces this point. Kahneman and Deaton (2010) identified a sufficiency threshold of approximately **$75,000 per year (2008 USD; ≈$105,000 in 2025 dollars)**, beyond which additional income no longer improved daily emotional experience, though life evaluation continued to rise. Killingsworth, Kahneman, and Mellers (2023) refined this, showing that while happiness rises steadily with income for many, a substantial minority still plateaus around $100,000. These findings converge with scarcity research: below sufficiency, financial stress imposes a **bandwidth tax** that reduces cognitive capacity (Mani et al., 2013), while debt structure itself shapes psychological functioning (Ong et al., 2019). Correctives must therefore operate at the right level: debt consolidation for safety, community and recognition for esteem, autonomy-supportive design for growth (Anderson & Butcher, 2007; Deci & Ryan, 2000). This reflects a **triadic design axiom**: stabilize physiology, scaffold belonging, and unlock autonomy.

Environment (E):

Institutions that reward financial returns untethered from real goods and services build structural incentives to extract in the symbolic layer. To prevent lock-in, long-lived assets should undergo lifecycle carbon checks, with reversible and modular infrastructure privileged. High-impact consumption domains—aviation/freight, car dependence, and building energy—should be targeted with combined standards, pricing, and social options (e.g., transit, heat-pump programs) so that the **low-impact path is the easy path**. This balances the **comparative dynamics of tension**: individual convenience vs. collective sustainability, short-term gain vs. long-term resilience.

4.8.7 Evaluation and Learning:

Systems must be tested in the open. Pre-registered 2×2 trials (e.g., [pricing × support] × [feedback × defaults]) should be conducted, with outcomes reported using RE-AIM metrics—Reach, Effectiveness, Adoption, Implementation, Maintenance (Glasgow et al., 1999). This surfaces real-world population impact, not just laboratory efficacy, and ensures that design levers are empirically grounded.

NiCE × Design Levers Matrix

Table 20 - NiCE × Design Levers Matrix

NiCE Axis	Design Strategy	Empirical Levers	Cross-Cultural / Philosophical Anchors
Nature (N)	Tie incentives to **real resources** (resource-indexed transfers, outcome-based contracts). Require lifecycle carbon checks; privilege modular/reversible infrastructure. Target high-impact consumption (aviation, freight, cars, buildings).	• Resource-indexed dividends (carbon/energy rents) • Outcome-based contracts (efficiency, demand reduction) • Standards + pricing + social options (e.g., transit, heat-pump programs)	• *Kohelet* 5:9 (insatiability of wealth) • Qur'an 9:34–35 (warning against hoarding) • Smith (1776/2012): value grounded in production
Consciousness (C)	Secure sufficiency, then pivot to **belonging, competence, autonomy, meaning**. Correct scarcity at the right level (debt relief, community, autonomy-supportive design).	• Scarcity bandwidth tax (Mani et al., 2013) • Debt structure effects (Ong et al., 2019) • Income–happiness sufficiency (Kahneman & Deaton, 2010; Killingsworth et al., 2023) • Self-determination theory (Deci & Ryan, 2000)	• Confucius, *Analects* 4.12 (righteousness > profit) • Plato, *Republic* VIII (oligarchy corrodes virtue) • Marx (1867/1996): M–M′ drift • Miller, *Death of a Salesman* (dignity reduced to money) • Scorsese, *Wolf of Wall Street* (finance spectacle)
Environment (E)	Make lock-in illegal prospectively. Align institutions with **real goods/services**. Evaluate openly with RE-AIM metrics.	• Lifecycle carbon checks for long-lived assets • Modular/reversible infrastructure • RE-AIM evaluation (Glasgow et al., 1999)	• *Bhagavad Gita* 2:47 (non-attachment to fruits of action) • *Dhammapada* 204 (contentment as wealth) • Sahdra & Shaver (2013): nonattachment reduces maladaptive materialism • Sys et al. (2024): nonattachment improves wellbeing

4.9 Neoliberal Incentives, Narcissistic Selection, and a NiCE-Aligned Alternative

4.9.1 Where the mechanics come from – Neoliberalism

"**Neoliberalism**" consolidated through mid-century networks (e.g., Mont Pèlerin) before becoming late-1970s policy common sense—deregulation, privatization, capital mobility, and fiscal consolidation (Harvey, 2005; Mirowski & Plehwe, 2009).

Inside firms, agency theory and shareholder-value primacy reframed managers as stock-price maximizers, operationalized via equity pay and **tournament** incentives (Friedman, 1970; Jensen & Meckling, 1976; Lazear & Rosen, 1981).

Macro outcomes are consistent with **market-power** and **superstar-firm** dynamics: rising markups, concentration, and a falling labor share (Autor, Dorn, Katz, Patterson, & Van Reenen, 2020; De Loecker, Eeckhout, & Unger, 2020).

4.9.2 How neoliberal reason reshapes subjectivity (and why narcissism pays)

Foucault's account of **governmentality** shows neoliberalism as a political *rationality* that makes individuals *entrepreneurial human capital* evaluated by market metrics (Foucault, 2008/1978–79; see also Brown, 2015).

Contemporary critical theory elaborates this transformation of citizenship into competitive self-commodification (Brown, 2015; Vaki, 2024). Contemporary philosopher Byung-Chul Han argues this regime replaces external discipline with **self-exploitation** and **performance**—producing exhibitionistic self-promotion, emotional commodification, **burnout**, and eroded relationality (Han, 2015; 2017).

Political-economy + psychoanalytic work explains the persistence of "**narcissistic rage**": when marketized ideals of the self are frustrated, defensive aggression and status displays re-entrench neoliberal forms rather than undoing them (Gammon, 2017). Cultural analysis of "**autoforms**" (autofiction, autotheory, influencer self-writing) shows how self-branding normalizes a marketable identity logic (King, 2025).

Empirically, the **attention economy** tightly couples visibility and metrics to status and reward; meta-analysis links narcissism to self-presentational social-networking behavior ($\rho \approx .17$: Gnambs & Appel, 2018), and large reviews tie metricized work stressors to burnout (Aronsson et al., 2017; OECD, 2022).

Mechanisms (selection pressures).

1. **Rewarding visibility & metrics:** Platforms and workplaces use quantifiable attention and KPIs as currencies; what "counts" is what's counted, encouraging performative self-presentation (Brown, 2015; Han, 2017; Muller, 2018).

2. **Self as entrepreneurial project:** Neoliberal governance reframes self-worth as continuous optimization and market success, shifting recognition toward extrinsic, status-indexed goals (Foucault, 2008; Brown, 2015; Vaki, 2024).

3. **Emotional commodification / affective labor:** "Professionalized positivity" and always-on availability monetize feeling; fragile self-esteem seeks validation via transactions/likes (Han, 2015; 2017; Hochschild, 1983).

4. **Defensive narcissism in politics:** When marketized identity fails, compensatory displays—sometimes mobilized as populist movements—reproduce neoliberal social forms (Gammon, 2017).

4.9.3 Consequences versus rewards (a sober balance)

Rewards. Liberalization and competitive pressure coincided with sector-specific innovation and efficiencies; superstar-firm research shows productivity advantages (Autor et al., 2020).

Consequences. IMF economists conclude core neoliberal policies—capital-account liberalization and fiscal consolidation—tend to **raise inequality** without clear growth gains (Ostry, Loungani, & Furceri, 2016).

Financialization encourages **extraction over production** (Krippner, 2005; Lazonick, 2014).

Markets can **crowd out moral motives**: market framings increase willingness to harm for money (Falk & Szech, 2013); poorly designed incentives undermine intrinsic motivation (Gneezy & Rustichini, 2000a, 2000b; see also Deci, Koestner, & Ryan, 1999).

Culturally, materialistic value orientation (status competition) correlates with **lower well-being** and **weaker sustainability behaviors** (Dittmar, Bond, Hurst, & Kasser, 2014; Isham et al., 2022).

4.9.4 Why these mechanics select for narcissism

Selection thesis. When reward systems center on **ranked tournaments**, **EPS-target obedience**, and **metricized visibility**, they create **high-variance, status-ranked contests**. These contexts disproportionately advantage **self-enhancing, attention-seeking** traits characteristic of narcissism—while pushing externalities (safety, ethics, ecology) off the balance sheet (Lazear & Rosen, 1981; Graham, Harvey, & Rajgopal, 2005; O'Boyle, Forsyth, Banks, & McDaniel, 2012).

Mechanism 1: Tournaments + short-term EPS → risk seeking and real-activity manipulation

What the incentives do. Rank-order pay **amplifies rivalry and risk-taking** by making relative position—rather than absolute value created—the thing that pays (Lazear & Rosen, 1981).

Pressure to "make the quarter" (EPS) leads managers to **sacrifice long-term value** or **shift operations** (discounting, overproduction, slashing discretionary spend) to hit benchmarks—classic real-activities manipulation (Graham et al., 2005; Roychowdhury, 2006).

Stretch goals can further narrow attention, **distort risk preferences**, and **raise unethical behavior** (Ordóñez, Schweitzer, Galinsky, & Bazerman, 2009). Together, these incentives reward **boldness and optics** over stewardship—fertile ground for narcissistic self-promotion.

Testable prediction A. Firms with **tournament-heavy** and **EPS-only** pay will show

(i) higher volatility of operating performance,
(ii) greater incidence of real-activity manipulation proxies (abnormal production costs, SG&A cuts), and
(iii) more restatements or misconduct events, relative to matched peers.

Mechanism 2: Narcissistic CEOs fit—and flourish in—high-variance contests

Observed behaviors. Narcissistic CEOs pursue **larger/more acquisitions**, **greater strategic dynamism**, and exhibit **more extreme, fluctuating performance** (Chatterjee & Hambrick, 2007). They also tend to **inflate their relative pay** and widen pay gaps within the top team (O'Reilly, Doerr, Caldwell, & Chatman, 2014). On the symbolic front, they are more prone to **attention-seeking CSR postures** whose performance links depend on motivation (Petrenko, Aime, Ridge, & Hill, 2016).

Testable prediction B. Under similar market conditions, **higher CEO narcissism** will predict **bigger, more frequent M&A**, **higher comp dispersion**, and **wider ROA/ROE variance**—especially when variable pay is tournament-like and guidance is EPS-centric.

Mechanism 3: Dark-Triad selection and conduct risk

Meta-analytic baseline. Across 245 samples (N≈44k), **Dark Triad traits**—including narcissism—show **moderate positive associations with counterproductive work behavior**, especially in contexts with power asymmetries or permissive norms (O'Boyle et al., 2012).

Narcissism also **inflates self-ratings** of leadership while being **negatively related to other-ratings**—a self-enhancement asymmetry that aids early selection but undermines later effectiveness (Judge, LePine, & Rich, 2006; see also meta-analysis: Grijalva, Harms, Newman, Gaddis, & Fraley, 2015).

Testable prediction C. Organizations with **high power distance** and **weak integrity controls** will show stronger links between leader narcissism and **CWB incidents**, relative to low-power-distance, high-monitoring settings.

4.9.5 Rewarded Narcissism Under Neoliberal Managerialism

Rewarded narcissism in neoliberal managerial environments emerges from a causal chain: metricization and short-horizon incentives select for visible, self-promoting leaders; those leaders pursue status capture rather than talent enablement; organizational culture and governance amplify toxic power dynamics that degrade team outcomes (retention, burnout, innovation) over the medium to long term (Braun, 2017; Chen et al., 2023; Dougherty & Natow, 2019).

Mechanisms with Supporting Citations

- **Selection and Promotion Bias** — Organizations favor charismatic, dominant candidates whose visibility and decisive signaling fit metricized reward structures, increasing the promotion likelihood of narcissistic managers (Braun, 2017).
- **Metricization and Short-Term Incentives** — KPIs and performance funding incentivize credit-claiming and KPI optimization over mentorship and resource provisioning, producing adaptive gains for self-aggrandizing behavior that are often costly later (Dougherty & Natow, 2019; Braun, 2017).
- **Toxic Leadership Effects** — Narcissistic leaders tend to appropriate credit, demand loyalty, suppress dissent, and elevate unethical risk, reducing psychological safety and subordinate voice (Chen et al., 2023; Rosenthal & Pittinsky, 2006).
- **Commodification of Relations** — Neoliberal managerialism converts relational and developmental work into commodified outputs, aligning managerial rewards with power accumulation rather than enabling talent (Dougherty & Natow, 2019).
- **Organizational Outcomes** — Empirical studies link narcissistic leadership and metric fixation to higher turnover, lower innovation sustainability, and increased employee stress and burnout (Braun, 2017; Chen et al., 2023).

Key Quantitative Indicators to Document the Phenomenon

- **Promotion Concentration**: share of managerial promotions awarded to high-visibility hires versus internal team builders (linked to Braun, 2017).
- **KPI-Short/Long Gap**: divergence between short-term KPI improvements and long-term quality/productivity (Dougherty & Natow, 2019).
- **Reward Concentration Index**: Gini-style measure of bonus/salary capture at managerial level correlated with training and development spend (Dougherty & Natow, 2019).
- **Climate Measures**: validated scales for perceived leader narcissism, psychological safety, and perceived supervisor support (Chen et al., 2023).
- **Retention and Burnout Metrics**: turnover rates, Maslach Burnout Inventory proxies, and team innovation persistence (Braun, 2017; Chen et al., 2023).

Practical Diagnostic Artifact

Constraint Audit Item — Measure — Trigger

- **Promotion bias** — % external/high-visibility hires promoted — >X% triggers governance review (Braun, 2017).
- **KPI distortion** — Short-term KPI improvement vs 3-year outcome delta — negative long-term delta triggers metric redesign (Dougherty & Natow, 2019).
- **Reward capture** — Managerial reward Gini — top decile > Y triggers redistribution and stewardship clause audit (Dougherty & Natow, 2019).

Mechanism 4: Metricized visibility and attention markets

When **visibility becomes currency**, self-presentation outcompetes service. Platform and workplace **metric fixation** (views, followers, OKRs reduced to narrow KPIs) encourages **performative signaling** over substance (Muller, 2018).

A meta-analysis across 57 studies links **grandiose narcissism** with **social-media self-presentation intensity** ($\rho \approx .17$), consistent with selection into visibility-rewarded arenas (Gnambs & Appel, 2018).

In finance, making **professional identity salient** increases **dishonesty** in lab tasks—evidence that **norm primes + competitive incentives** can erode ethical restraint (Cohn, Fehr, & Maréchal, 2014).

Testable prediction D. Units with **high external-visibility KPIs** (media mentions, follower counts) but **no verifiable repair metrics** (safety, emissions, remediation) will display **higher rates of misreporting and reputational incidents**.

4.9.5 Synthesis: Why selection tilts toward narcissism

Put together: **ranked prizes** + **short-term earnings obedience** + **visibility rewards** form a payoff landscape where **symbolic wins** (status, EPS optics, media attention) are what pay. People who seek and optimize for those signals—**even at the expense of others**—are more likely to **emerge**, even if they are not more **effective** stewards in the long run (Chatterjee & Hambrick, 2007; Grijalva et al., 2015).

Unless tempered by **design** (long-horizon metrics, polycentric accountability, verified repair), the system **selects for narcissistic phenotypes** and **externalizes social/ecological costs** (O'Boyle et al., 2012; Roychowdhury, 2006; Graham et al., 2005).

4.9.6 A NiCE-aligned alternative (rational, testable, incentive-compatible)

Premise. Profit becomes publicly legitimate when the money signal is calibrated to reality:

biophysical budgets (N),

human wellbeing and attention integrity (C), and

accountable institutions (E).

The NiCE alternative replaces **visibility-for-its-own-sake** with **verifiable improvements** on these three axes.

Principle N (Nature): Align money with biophysical limits

Rationale. Empirical syntheses show we have already **overshot multiple Earth-system boundaries** (e.g., climate, biosphere integrity, novel entities), meaning unpriced ecological costs systematically leak from markets into public health and future risk (Richardson et al., 2023).

At the same time, **fossil energy remains massively underpriced** once local pollution and climate damages are included, sustaining overuse and rent-seeking (Black, Liu, Parry, & Vernon, 2023).

Decades of **consumption-based accounting** demonstrate that, absent hard caps and full costing, economic growth rarely **absolutely** decouples from material throughput (Wiedmann et al., 2015).

Policy/firm levers.

Price real externalities; remove harmful subsidies.

> Internalize residual climate/air-pollution damages with carbon pricing or performance standards and **phase out rent-creating tax expenditures** (Black et al., 2023).

Budget-first strategy.

> Bind capital allocation to **science-based caps** (e.g., Paris-consistent carbon budgets; basin-level water limits) and adopt **double-materiality** risk reporting so financial and *impact* materiality co-determine strategy (Richardson et al., 2023).

Throughput metrics, not just intensities.

> Track **absolute** Scope 1–3 emissions, lifecycle materials and water, and require **declining totals** over time—intensity-only targets are prone to greenwishing (Wiedmann et al., 2015).

Testable predictions.

Firms that adopt NiCE-N (pricing + caps + absolute targets) will show **declining total footprints** at the enterprise level while maintaining or increasing value added, vs. matched controls (difference-in-differences).

Principle C (Consciousness): Reward stewardship, not spectacle

Rationale. Poorly designed extrinsic rewards can **crowd out** intrinsic motivation (Deci, Koestner, & Ryan, 1999).

"Tournament" and **EPS-only** pay designs tilt behavior toward status display, risk-seeking, and short-term optics (Lazear & Rosen, 1981), while **narcissistic leadership** is empirically associated with larger, attention-seeking acquisitions and more volatile performance (Chatterjee & Hambrick, 2007) and with higher counterproductive behavior risk down the organization (O'Boyle, Forsyth, Banks, & McDaniel, 2012).

Design levers.

Multi-capital scorecards in compensation.

Tie a *meaningful share* of variable pay to **wellbeing, repair, resilience, and emissions** alongside financials; weight long-horizon components and pre-register metrics to minimize gaming (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b).

Anti-narcissism governance.

Require **independent compensation committees**, **clawbacks**, and **balanced KPIs** (financial + NCE) for executives to dampen "swing-for-the-fences" incentives (Chatterjee & Hambrick, 2007; O'Boyle et al., 2012).

Attention integrity by design.

Audit for dark patterns; provide "**why-this?**" explanations and user controls; evaluate **informed dwell** and **wellbeing deltas** as first-class performance metrics.

Testable predictions.

Relative to EPS-only peers, firms adopting NiCE-C compensation will exhibit **lower accident/misconduct incidence**, **higher retention**, and **more stable ROIC**, with moderated variance during stress periods.

Principle E (Environment/Institution): Polycentric, accountable rules

Rationale. Where resources and risks are shared, **polycentric governance** with clear boundaries, monitoring, graduated sanctions, and conflict-resolution outperforms both pure privatization and pure centralization (Ostrom, 2009).

At the macro level, evidence on **inequality**, **market power**, and the mixed growth returns to core neoliberal policies justifies **broadening fiduciary purpose** beyond narrow shareholder primacy (Ostry, Loungani, & Furceri, 2016; De Loecker, Eeckhout, & Unger, 2020; Autor, Dorn, Katz, Patterson, & Van Reenen, 2020).

Institutional levers.

Polycentric commons compacts.

Co-manage water, forests, fisheries, and data with local users + state regulators + independent monitors; publish **audit logs/APIs** so external parties can verify compliance (Ostrom, 2009).

Stakeholder fiduciary duties.

Expand board duties to **material stakeholders** (workers, communities, ecosystems) where their rights/interests are directly affected; require **impact-risk reporting** and remediation plans (Ostry et al., 2016; De Loecker et al., 2020; Autor et al., 2020).

Adaptive trials with kill-switches.

Roll out major policies via **stepped-wedge** pilots; halt or modulate when **N/C/E guardrails** are breached.

Testable predictions.

Sectors adopting polycentric compacts plus stakeholder duties will show **faster incident detection**, **shorter remediation times**, and **fewer boundary breaches** than sectors governed by disclosure-only regimes.

4.9.6 Policy exemplar (translation to practice)

New Zealand's Wellbeing Budget reframes fiscal targeting beyond GDP, funding programs against **multi-domain wellbeing metrics** (New Zealand Treasury, 2019). NiCE adapts this logic inside firms and portfolios by

(i) tying capital budgeting to **N-caps**,
(ii) paying for **C-outcomes**, and
(iii) enforcing **E-audits** with public verifiability.

4.9.7 Comparative claim (NiCE vs. neoliberal selection)

Where **neoliberal reason** metricizes *recognition* (visibility, EPS optics), **NiCE re-specifies payoffs** so that **visibility without repair creates no surplus value**. Attention must translate into **verifiable improvements** in **N–C–E** outcomes. That flips selection pressure from **performative narcissism** to **stewardship competence**—and does so with rules that are measurable, auditable, and falsifiable.

The NiCE Profit Test (one page)

Use this diagnostic before green-lighting a strategy, product, or M&A. A "No" on any bolded item requires redesign or fails the test.

N — Nature (Biophysical Integrity)

1. **Boundary-safe?** Quantitatively consistent with science-based targets (climate, biodiversity, water, pollution). Cite model and margin of safety.
2. **No hidden subsidies?** Unit economics hold **without** environmentally harmful subsidies/tax expenditures (IMF definitions).
3. **Full-costed?** Prices include lifecycle externalities (scope 1–3; upstream/downstream). Sensitivity analysis shows viability after internalization.

C — Consciousness (Human Flourishing & Attention Ecology)

1. **Intrinsic-compatible?** Incentives won't crowd out intrinsic motivations essential to quality, safety, or care (check for Gneezy-Rustichini effects).
2. **Anti-narcissism guardrails?** Governance mitigates status-seeking distortions (balanced KPIs, clawbacks, independent board evals).
3. **Well-being co-benefits?** Clear, measured benefits to users/workers (e.g., reduced toxic stress, skill growth, autonomy).

E — Environment (Institutional Design & Fair Competition)

1. **Creates—not extracts—value?** Demonstrable productive investment, not primarily rent-seeking (buybacks, regulatory arbitrage).
2. **Polycentric compliance?** Aligns with local/community co-governance where commons are affected; transparent grievance/audit pathways.
3. **Distribution-aware?** Material risks/benefits aren't offloaded to the least powerful; redress mechanisms budgeted and time-bound.

Decision rubric

Pass*:* All nine satisfied.

Revise*:* Any one N-fail or two C/E fails.

Fail*:* Two or more N fails or any unmitigable harm.

4.10 The "attention economy" vs. essential work: A NiCE analysis of trends, mechanisms, and consequences

4.10.1 Framing question

Are rising monetized "influencer/creator" careers (e.g., YouTube/TikTok influencing, subscription platforms) diverting talent from **real-value** activities—healthcare, education, caregiving, food production, infrastructure, and essential technical services—and, if so, by what mechanisms? Or are both trends co-produced by higher-order drivers (prices, policy, demographics, technology, platform incentives)?

4.10.2 What we know empirically (the supply side of essential work)

Across OECD and U.S. indicators, **demand for essential services is outpacing workforce supply**, especially in care and education:

- **Long-term care and health**: OECD documents persistent shortages, deteriorating job quality, and a falling ratio of long-term-care workers per 100 older adults in many countries (low pay, part-time contracts, high risks), with explicit warnings that shortages will "reach socially unacceptable levels" without structural fixes (OECD, 2023a, 2023b).

- WHO projects a **global** health-worker shortfall on the order of **11–15 million by 2030**, depending on the model (WHO, 2025; Scheffler et al., 2018). In the U.S., **home health and personal care** jobs are among the largest and fastest-growing occupations (projected +17% 2024–2034; ~766k openings/year), yet remain low-paid and physically/emotionally demanding (U.S. Bureau of Labor Statistics [BLS], 2024).

- **Education**: U.S. **teacher compensation** has fallen far behind peers with similar education: a record **26–27% wage penalty** in 2023–2024, even after accounting for benefits, with many districts reporting vacancies (Economic Policy Institute [EPI], 2024, 2025). Housing affordability near schools has also deteriorated for teachers, compounding retention problems (EPI, 2024; Redfin analysis summarized by news reports).

- **Infrastructure & skilled trades**: U.S. construction is short **~0.5 million** workers **on top** of normal hiring in 2024; similar deficits persist into 2025–2026, driven by retirements, megaprojects, and training bottlenecks (Associated Builders and Contractors [ABC], 2024; NCCER, 2025). Electrification/data-center build-outs are already colliding with **electrician** shortages (Reuters, 2025).

- **Child care/early education**: National surveys show **4 in 5 centers understaffed**, with low wages the dominant reason educators leave; the lapse of stabilization funds in 2023–2024 accelerated closures (NAEYC, 2023–2025).

Bottom line: Independent of the creator economy, essential sectors show **structural shortfalls** traceable to pay, conditions, demographics, training pipelines, and policy design.

4.10.3 What we know about the creator/attention economy

Reliable financials show the creator sector's rapid growth and **heavy right-tail payoff concentration**:

- **Platform scale and payouts**: One large subscription platform reported **>$5.6 billion** in gross fan payments in 2022 and **>$6.6 billion** in 2023, with creators typically retaining ~80%; 2024–2025 filings/news point to continued growth (Business Insider, 2023; Forbes, 2024; Financial Times, 2025).

- **Distribution matters**: Industry reporting and surveys indicate **extreme income skew**—a small fraction earn the majority of revenue (consistent with tournament-style incentives and attention markets), although precise academic estimates are still emerging. (Business Insider, 2023; sector reports).

Interpretation: The creator economy expands **opportunities** for some and **status visibility** for many, but its aggregate labor share is still small relative to health, education, and infrastructure employment. The main risk is **selection pressure**: when **visibility and metrics** are highly rewarded, they can shape **career aspirations** and **time allocation**—especially for youth—without guaranteeing broad social returns (see mechanisms below).

4.10.4 Does the creator economy cause essential-sector shortfalls?

Short answer. Direct **causal** evidence is limited. Current shortages in teaching, caregiving, skilled trades, and health are **well explained** by wages/benefits, working conditions, training bottlenecks, demographics, immigration policy, and public financing (OECD, 2023a, 2023b; U.S. Bureau of Labor Statistics [BLS], 2024; Economic Policy Institute [EPI], 2024, 2025; Associated Builders and Contractors [ABC], 2024). That said, **NiCE** highlights **indirect channels** through which the "attention economy" can **tilt marginal choices** toward visibility-based careers.

Indirect channels (NiCE)

Consciousness (C): Status & attention incentives

Tournament/metricized environments **reward visibility and short-term recognition**, shifting aspirations toward performative contests. Experimental and field evidence shows **market framings can crowd out moral motives** (Falk & Szech, 2013) and that **poorly designed rewards erode intrinsic motivation** (Gneezy & Rustichini, 2000a, 2000b; Deci, Koestner, & Ryan, 1999).

Culturally, **materialistic/status orientations** are associated with **lower well-being** and **weaker sustainability behaviors**, indicating misalignment with public-service motives (Dittmar, Bond, Hurst, & Kasser, 2014; Isham et al., 2022).

Environment/Institutions (E): Relative payoff structures

Allocation-of-talent theory predicts that when **private returns** are higher in rent-seeking or status markets than in social production, **talent flows there**—even if **social returns** are lower (Baumol, 1990; Murphy, Shleifer, & Vishny, 1991).

Financialization amplifies this gradient by channeling effort toward symbolic extraction and highly visible tournaments (Philippon, 2015). By analogy, if platforms (and some finance/media roles) **out-pay or out-status** caregiving/teaching, they will **attract marginal entrants**—not necessarily in huge numbers, but **enough to matter** at the margin in shortage occupations.

Nature (N): Macro demand & demographics

> Aging populations raise **care needs**; "cost disease" in labor-intensive services constrains productivity-linked wage growth; **immigration and training frictions** slow supply. These **higher-order drivers** explain the lion's share of observed shortfalls; the creator economy acts more as an **amplifier of status/aspiration gradients** than a root driver (OECD, 2023a, 2023b; World Health Organization [WHO], 2025; BLS, 2024).

From a NiCE perspective however, we see little point in blaming creators, but interrogate the **rationality of systemic incentives** that **absorb, normalize, and prefer** a rapidly growing set of occupations yielding **symbolic, attention-based returns** while leaving **widening gaps** in careers that **materially provision basic human needs**. A rational system should theoretically **re-specify payoffs** so that *visibility without verifiable repair produces no surplus value*; attention should count **only when** it translates into measurable improvements across **Nature (N), Consciousness (C), and Environment/Institutions (E)** outcomes.

4.10.5 Why the "visibility premium" looks rational (but isn't): a consolidated NiCE analysis – Diagnosis (NiCE): how attention markets skew value

N — Nature (biophysical and demographic constraints).

Essential services—care, health, education, infrastructure—are intrinsically labor-intensive and resist rapid productivity gains, so their relative costs rise even as wages often lag, depressing supply (Baumol, 2012). Markets also **underprice externalities**, especially climate and health damages from fossil energy, creating illusory private profitability in activities that shift costs onto ecosystems and future health (Black, Liu, Parry, & Vernon, 2023).

With **six of nine planetary boundaries already transgressed**, ignoring absolute ecological caps systematically misdirects capital toward symbolic yield rather than real repair (Richardson et al., 2023). *Implication:* without caps and full-cost pricing, attention capture looks "cheap," while care and maintenance look "expensive," even when the latter deliver higher social returns.

C — Consciousness (motives, attention, aspiration).

Market framings and **metricized visibility** crowd out moral restraint and undermine **intrinsic motivation**—the motive structure that sustains caregiving and teaching (Falk & Szech, 2013; Deci, Koestner, & Ryan, 1999; Gneezy & Rustichini, 2000a, 2000b). Materialistic/status orientations correlate with lower well-being and weaker stewardship behaviors, amplifying the salience of spectacle over service (Dittmar, Bond, Hurst, & Kasser, 2014; Isham et al., 2022). Neurobehavioral evidence explains the grip of attention markets: money and money-like symbols act as conditioned reinforcers that recruit reward circuitry, making symbolic payoffs feel primary even when they are not (Lea & Webley, 2006; Sescousse, Caldú, Segura, & Dreher, 2013; Vohs, Mead, & Goode, 2006). *Implication:* when short-term recognition dominates, **performative effort** outcompetes **stewardship effort**.

E — Environment/Institutions (rules and payoff architecture).

Talent flows to privately high-return arenas—even when social returns are lower (Baumol, 1990; Murphy, Shleifer, & Vishny, 1991). **Financialization** magnifies returns to symbolic extraction (trading, attention sales, balance-sheet engineering) over production (Krippner, 2005; Philippon, 2015). In essential sectors, **monopsony power** and fragmented bargaining suppress wages below marginal product, shrinking supply (Staiger, Spetz, & Phibbs, 2010). Institutions also exhibit **metric fixation**—over-rewarding what's easy to count (clicks, EPS) and under-rewarding repair (learning, uptime, prevention) (Muller, 2018). *Implication:* rules systematically **misprice essential work** and **overprice symbolic attention**.

Causal summary.

Observed shortfalls in essential sectors are co-determined by pay, conditions, demographics, and policy design; attention markets **tilt marginal choices** by raising perceived returns to visibility relative to repair. The prudent response is to **fix prices, pay, and pipelines** where social returns are highest—not to blame creators.

4.10.6 Forward-looking implications and predictions

N (Nature).

> Under-resourced care, education, public health, and infrastructure yield rising unmet needs, burnout, and degraded human capital—costs that compound over time (OECD, 2023a, 2023b; WHO, 2025).

Prediction N1:

> Organizations adopting **full-cost pricing** plus **absolute ecological budgets** (for carbon, water, materials) will show **declining total footprints** and **lower transition risk** with stable/improving value-added versus matched controls (Wiedmann et al., 2015; Richardson et al., 2023; Black et al., 2023).

C (Consciousness).

> Hyper-visibility and tournament incentives redirect aspiration when essential jobs are low-status/low-pay; redesigning rewards toward verified repair re-anchors attention to public-value work (Falk & Szech, 2013; Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b).

Prediction C1:

> **Multi-capital pay** (well-being, safety, repair/resilience, emissions alongside financials) reduces misconduct and churn and curbs earnings-management relative to EPS-only designs (O'Boyle, Forsyth, Banks, & McDaniel, 2012).

E (Environment/Institutions).

You get what you pay—and praise—for: wage floors, training pipelines, targeted immigration for shortage roles, and outcome-relevant metrics will re-balance supply toward essentials (Baumol, 1990; Murphy et al., 1991; OECD, 2023a; BLS, 2024; ABC, 2024; EPI, 2024, 2025).

Prediction E1:

Sectors with **polycentric compacts** and **stakeholder duties** achieve faster incident detection, shorter remediation, and fewer boundary breaches than disclosure-only peers (Ostrom, 2009; Autor, Dorn, Katz, Patterson, & Van Reenen, 2020; De Loecker, Eeckhout, & Unger, 2020).

4.10.7 Design levers consistent with NiCE (rational, testable, incentive-compatible)

N — Budget-first, full-cost money.
Price residual harms (carbon/air pollution) and phase out harmful energy subsidies; bind capital allocation to **science-based caps** with double-materiality risk reporting; track **absolute** Scope 1–3 emissions and material/water footprints (Black et al., 2023; Richardson et al., 2023; Wiedmann et al., 2015).

C — Protect intrinsic motives; reward repair, not spectacle.
Adopt **multi-capital compensation** with preregistered KPIs; ban **dark-pattern** attention hacks; measure **informed dwell** and well-being deltas; strengthen leadership guardrails (independent comp committees, clawbacks) to dampen narcissistic "swing-for-the-fences" risk (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b; Chatterjee & Hambrick, 2007; O'Boyle et al., 2012).

E — Polycentric governance; pay for outcomes that matter.
Co-manage shared resources (water/forests/data) with monitoring, graduated sanctions, and **audit APIs**; broaden fiduciary duties where public goods are at stake; require impact-risk and remediation plans; deploy **stepped-wedge** rollouts with **kill-switches** and evaluate via **RE-AIM** (Ostrom, 2009; Ostry, Loungani, & Furceri, 2016; De Loecker et al., 2020; Autor et al., 2020; Glasgow, Vogt, & Boles, 1999; Hemming, Haines, Chilton, Girling, & Lilford, 2015).

4.10.8 Operationalization: what "re-specifying payoffs" looks like

1. **Procurement & reimbursement:** Public and large buyers pay **premiums for verified repair** (avoided hospital admissions, learning gains, system uptime), not for visibility.

2. **Public dashboards:** Publish **N–C–E scorecards** (absolute footprints; user/patient well-being; safety/resilience) as the basis for bonuses and eligibility for public funds.

3. **Talent pipelines:** Fund apprenticeships and loan-forgiveness in shortage roles; align visas where domestic pipelines are slow; reserve prestige prizes for **measurable public value** (EPI, 2024, 2025; ABC, 2024; BLS, 2024).

4. **Capital markets:** Funds marketed as “impact” must prove **N–C–E improvements**; non-repair visibility yields **zero alpha credit**.

Burden of proof flips: visibility businesses must demonstrate verifiable N–C–E co-benefits—or forgo privileged access to public capital, subsidies, or distribution.

Scope conditions and limits

- **Complementarity:** Attention markets can aid repair (e.g., public-health campaigns, skills outreach) when tied to **outcome-based contracts**.
- **Equity:** Pair ecological pricing with **dividends or targeted transfers** to avoid regressive effects (Ostry et al., 2016).
- **Measurement risk:** Guard against Goodhart’s Law via **independent audits**, **pre-registered KPIs**, and **triangulated measures** (Muller, 2018).

4.11 Money as self-referential signal:

Claim. Money—an exquisitely human construct—enables coordination at scale but, unlike calories, water, or shelter, it bears **no direct tie to survival**. As monetary signs expand and circulate faster than the biophysical realities they are meant to represent, they become **self-referential**: attention, prices, and paper valuations can rise even as soils, species, water tables, and social bonds erode. In NiCE terms, when **Nature’s budgets (N)**, **Consciousness & motivation (C)**, and **Environment/Institutions (E)** lose calibration with one another, feedback loops reward **spectacle and short-term extraction** over **provisioning, stewardship, and long-horizon care**.

4.11.1 How money colonizes attention and motivation (C)

For humans, money is not just a medium of exchange but a powerful conditioned reinforcer. Neuroeconomic research shows it robustly recruits dopaminergic reward circuitry despite lacking nutritive or survival value (Lea & Webley, 2006; Sescousse, Caldú, Segura, & Dreher, 2013). Unlike a starving lion—attuned to primary rewards—that would ignore a fistful of currency to seize the hand holding food, humans often pursue currency itself, sometimes destroying the hand to obtain the money it carried. Across history and markets, monetary signals have repeatedly incentivized destruction, waste, and exploitation, severing price from provisioning.

Illustrative cases of monetary irrationalization

1. **Bison hides over food.** In the late 19th century, unlike aboriginal practices using every part of the animal, industrial hide hunters exterminated millions of American bison, widely leaving meat to rot while hides were shipped for profit—ecological and nutritional resources destroyed in pursuit of monetized pelts (Isenberg, 2000).

2. **Diamonds and blood diamonds.** Unlike our lion who ignores the stone, humans kill for it. For decades, De Beers engineered artificial scarcity, embedding diamonds as essential status markers despite their limited intrinsic utility (Epstein, 1982; Spar, 2006). In the 1990s, "blood diamonds" financed brutal wars in Sierra Leone, Angola, and the DRC, with civilians maimed or killed to secure alluvial fields (Smillie, 2010; Campbell, 2002). Despite the Kimberley Process (2003), loopholes persist, and conflict-linked stones still enter supply chains (Le Billon, 2008; Global Witness, 2011). Here money colonized desire so deeply that consumers paid premiums for symbolic sparkle while ignoring the blood it masked.

3. **Ivory trade and elephant poaching.** Rising ivory prices in Asia during the 2010s tripled poaching rates, financing organized crime and hollowing ecosystems until regulatory bans partially reversed incentives (Underwood, Burn, & Milliken, 2013).

4. **Cod fisheries collapse.** Canada's 1992 Northern Cod moratorium followed decades of profit-driven overfishing; entire coastal economies collapsed, showing how chasing price signals can erase a renewable food base (Hutchings & Myers, 1994).

5. **Opioid epidemic.** Purdue Pharma's marketing of OxyContin prioritized profit over safety, fueling addiction and overdoses. In 2020, the company pleaded guilty to federal charges and faced multibillion-dollar penalties (Van Zee, 2009).

6. **Insulin rationing.** U.S. insulin prices remain multiple times higher than in peer countries, forcing cost-related underuse and avoidable medical crises (Herkert et al., 2019).

7. **Surprise medical billing.** Before the No Surprises Act (2022), out-of-network billing exploited patient vulnerability in emergencies, generating revenue unlinked from service quality (Cooper et al., 2020).

8. **Pharma "pay-for-delay."** Brand firms paying generics to delay entry prolonged monopoly pricing, enriching incumbents without improving drugs (Hemphill & Wu, 2013).

9. **Daraprim price spike.** Turing Pharmaceuticals raised the price of Daraprim from $13.50 to $750 overnight in 2015, leveraging monopoly control for profit without innovation (Pollack, 2015).

10. **Fossil fuels underpriced.** IMF estimates implicit subsidies at $7 trillion in 2022, as markets ignore climate and health damages—systematically over-rewarding energy use and underfunding repair (Black, Liu, Parry, & Vernon, 2023).

11. **Housing financialization.** Treating housing as a global asset class—via REITs and speculative investment—prices out residents and commodifies shelter, privileging capital flows over social need (Fields & Uffer, 2016).

12. **Corporate landlord rents.** Large U.S. rental firms charged higher rents and fees than small landlords, extracting wealth from necessity without commensurate value (Raymond & Moore, 2022).

13. **Private prison contracts.** Mississippi inmates in private facilities served ~90 extra days on average due to conduct violations, reflecting contractual incentives for longer confinement (Mason, 2012).

Synthesis

Across these cases, the mechanism is consistent: when money and status dominate attention, actors optimize for whatever is monetizable (hides, diamonds, ivory, rents, prescriptions), while unpriced outcomes (ecological integrity, human health, equitable shelter, basic dignity) are neglected. In NiCE terms, these examples show how misaligned monetary signals distort **Consciousness** (motives), degrade **Nature** (stocks), and warp **Environment/Institutional rules**—rewarding spectacle, scarcity engineering, and extraction over stewardship and repair.

Crowding-out and market priming.

Priming with money reduces helping and increases social distance (Vohs, Mead, & Goode, 2006). Market framings can **lower moral restraint** (Falk & Szech, 2013), and **poorly designed rewards** can **undermine intrinsic motivation**—the motive structure indispensable to care, teaching, and craftsmanship (Deci, Koestner, & Ryan, 1999; Gneezy & Rustichini, 2000a, 2000b).

Status orientation and well-being.

Materialistic/status values correlate with **lower well-being** and **weaker sustainability behaviors**, indicating a motivational drift away from pro-social, repair-oriented action (Dittmar, Bond, Hurst, & Kasser, 2014; Isham et al., 2022).

Prediction C1.

Units that

(i) frequently prime money/status and
(ii) pay narrowly for visibility/short-term metrics will show **lower prosocial behavior**, **higher misconduct/accidents**, and **worse long-run quality** than matched controls that use **multi-capital, purpose-compatible** incentives.

4.11.2 When prices detach from biophysical reality (N)

Overshoot is measurable.

Current syntheses conclude humanity has crossed **six of nine planetary boundaries** (e.g., climate, biosphere integrity, novel entities)—evidence of systemic overshoot (Richardson et al., 2023).

Underpricing harm sustains overuse.

Fossil energy remains **massively underpriced** once climate and health damages are internalized, sustaining throughput and rent-seeking (Black, Liu, Parry, & Vernon, 2023).

Decoupling is rare without caps.

With consumption-based accounting, national **material footprints** tend to **rise with GDP**; robust **absolute** decoupling is uncommon without binding constraints (Wiedmann et al., 2015).

Prediction N1.

Firms adopting **absolute ecological budgets** (carbon/water/materials) plus full-cost accounting will show **declining total footprints** and **lower transition risk** than peers using **intensity-only** targets.

4.11.3 Rules that make drift look "rational" (E)

Allocation of talent.

When private returns are higher in **symbolic extraction** (trading, attention sales, balance-sheet engineering) than in social production, talent **rationally flows** there—even if **social returns** are lower (Baumol, 1990; Murphy, Shleifer, & Vishny, 1991). Financialization amplifies this drift (Krippner, 2005; Philippon, 2015).

Metric fixation.

Institutions **over-reward what's easy to count** (EPS, clicks) and under-reward **repair** (learning gains, prevention, resilience)—a canonical metrics failure (Muller, 2018).

Labor power asymmetries.

Monopsony and fragmented bargaining in essential sectors **suppress wages below marginal product**, shrinking supply despite rising need (Staiger, Spetz, & Phibbs, 2010).

Prediction E1.

Jurisdictions that

(i) broaden fiduciary focus beyond narrow shareholder primacy,
(ii) tie access to public capital/procurement to **verified repair outcomes**, and
(iii) reduce labor monopsony will show **faster remediation**, **lower vacancy/turnover** in essential services, and **fewer boundary breaches** than disclosure-only peers.

4.12 Are we capable of understanding the "what, why, and how"?

We imagine it is helpful if we can re-anchor seeing and judging to NiCE-coherent evidence:

1. **What** is happening: track **absolute** flows and stocks (Scope 1–3 emissions, water tables, species abundance; staff-to-need ratios; burnout/retention)—not just prices and followers (Richardson et al., 2023; Wiedmann et al., 2015).
2. **Why** it's happening: map **incentive pathways** (money/status primes, reward design, market power) to outcomes using **pre-registered** metrics and quasi-experiments (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b; Staiger et al., 2010).
3. **How** to bend the curve: **re-specify payoffs** so that **visibility without verifiable repair produces no surplus value**; attention "counts" only when it **measurably** improves N–C–E outcomes.

4.12.1 NiCE-aligned design (practical, testable, incentive-compatible)

- **Budget-first money (N).** Internalize residual harms (pricing/standards), phase out harmful subsidies, and bind strategy to **absolute** ecological budgets with **double-materiality** risk reporting (Black et al., 2023; Richardson et al., 2023).
- **Protect intrinsic motives (C).** Replace EPS/visibility-only pay with **multi-capital scorecards** (well-being, safety, repair, resilience, emissions) and ban dark-pattern attention hacks (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b).
- **Polycentric accountability (E).** Co-manage shared resources with **monitoring, graduated sanctions, and audit APIs**; condition public funds and procurement eligibility on **verified N–C–E improvements** (Ostrom, 2009).

System-level prediction. Portfolios and firms adopting NiCE design will show **better risk-adjusted durability** (fewer regulatory shocks/scandals, steadier margins) **and** measurable improvements in N–C–E indicators relative to benchmarks optimized for symbolic visibility.

4.12.2 The Irrationalization Cascade: How Money Rewrites N–C–E

Many independent forces shape social outcomes. Norms, technologies, biological drives, institutions, ecological limits, information systems, and power structures all motivate behavior, redirect effort, and redefine value. Money has penetrated every one of these domains. Yet unlike water, food, or shelter, it bears no direct tie to survival. Instead, it increasingly distorts the very systems it touches—irrationalizing incentives even as it grows more abstract itself.

The contrast is instructive. Confronted with a fistful of currency, a hungry lion would sniff and ignore it, striking instead at the hand that holds it. A human, by contrast, might seize the money—even to the point of harming another—demonstrating how thoroughly our species has been conditioned to treat symbolic value as though it were material sustenance (Lea & Webley, 2006; Sescousse, Caldú, Segura, & Dreher, 2013).

Viewed through the NiCE framework, money rewires human consciousness to privilege its symbolic logic over ecological reality. Its rational connection to material provisioning has grown increasingly tenuous, yet its grip on behavior tightens. Experiments confirm that monetary and market framings crowd out moral restraint (Falk & Szech, 2013) and that extrinsic rewards can undermine intrinsic motivation—the very motive structure essential to caregiving, teaching, and stewardship (Deci, Koestner, & Ryan, 1999; Gneezy & Rustichini, 2000a, 2000b). Our thesis is that **Nature, Consciousness, and Environment (N–C–E) are interdependent**: shifts in one domain cascade through the others, reshaping norms, incentives, and outcomes in relational ways.

As money expands, it elevates abstract signs—visibility, positional advantage, short-term extraction—above the practices that secure durable wellbeing. The result is not a single cause but a systemic distortion: monetary signs displace material realities, feedback loops amplify spectacle over stewardship, and institutions normalize incentives that reward appearance over repair (Murphy, Shleifer, & Vishny, 1991; Muller, 2018).

Among the broad spectrum of consciousness implications, money as a human invention affords us something no other species possesses: the ability to detach our valuation systems from the natural substrates that sustain us. It should be no surprise, then, that this detachment is precisely what occurs. The process is gradual enough to be tolerated, but pervasive enough to saturate norms, technologies, institutions, and minds. In the context of a population that grows while ecological resources shrink—and with our activity degrading the very environment that sustains us and countless other species (Richardson et al., 2023; Black, Liu, Parry, & Vernon, 2023)—the question presses: are we still capable of seeing, through a clear lens, the *what, why, and how* of the system we ourselves are undermining?

This naturally begs the question: is money a natural "Trojan Horse" vehicle for irrationalizing the institutions and mechanics it touches?

4.13 Money as a “Trojan Horse”? A NiCE Analysis

Hypothesis. As monetary systems become more abstract and self-referential, they can infiltrate (and sometimes distort) human motivation and institutional design in ways that decouple symbolic gain from biophysical reality—functioning like a “Trojan Horse” that rationalizes perverse incentives inside the very systems it permeates.

NiCE lens.

- **E (Environment):** Monetary/media architectures, metrics, platforms, market rules.
- **C (Consciousness):** Salience, valuation frames, moral appraisal, intrinsic motives.
- **N (Nature):** Energetic costs, reward circuitry, stress/arousal, self-regulation.

We assess mechanisms, boundary conditions, and testable implications.

4.13.1 Mechanisms & evidence

M1. Symbol–substrate drift (E→C/N): Money becomes the message

- **Claim.** As money transacts money (finance-on-finance), signals can detach from real provisioning and steer behavior toward symbolic wins.

- **Support.** Classic sociology and economic anthropology show that money's meaning is socially constructed and plastic (Simmel, 1978/1900; Zelizer, 1994), making drift plausible when measures become targets (Goodhart dynamics) (Strathern, 1997; Muller, 2018). Rent-seeking theory predicts talent reallocates toward extraction when returns to manipulation exceed real production (Murphy, Shleifer, & Vishny, 1991). *(Simmel, 1978/1900; Zelizer, 1994; Strathern, 1997; Muller, 2018; Murphy et al., 1991).*

M2. Market framing can relax moral constraints (E→C)

- **Claim.** Trading contexts can weaken deontic restraints and normalize harmful bargains.
- **Support.** In lab markets where participants decide about harming mice, market conditions increased acceptance of harm relative to individual choice baselines (Falk & Szech, 2013).
  (Falk & Szech, 2013).

M3. Monetary incentives can crowd out intrinsic motives (E→C; C↔N)

- **Claim.** Extrinsic pay can undermine curiosity, care, and stewardship—especially when it signals distrust or commodifies previously pro-social domains.
- **Support.** Meta-analysis: many reward types reduce intrinsic motivation for interesting tasks (Deci, Koestner, & Ryan, 1999). Field experiments show "a fine is a price" (parents arrive later after day-care fines) and "pay enough or don't pay at all" (small payments reduce prosocial effort) (Gneezy & Rustichini, 2000a, 2000b).

  In public goods and civic contexts, incentives can substitute for social preferences (crowding out) or—if designed carefully—complement them (crowding in) (Bowles, 2008; Bowles & Polanía-Reyes, 2012; Frey & Oberholzer-Gee, 1997). Blood donation evidence is mixed: gender-specific crowd-out (Mellström & Johannesson, 2008) vs. later reviews finding net positive supply effects in some settings (Niza, Tung, & Marteau, 2013; Janssen et al., 2021).
  (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b; Bowles, 2008; Bowles & Polanía-Reyes, 2012; Frey & Oberholzer-Gee, 1997; Mellström & Johannesson, 2008; Niza et al., 2013; Janssen et al., 2021).

M4. Money primes self-sufficiency and social distance (E→C; replication caution)

- **Claim.** Making money salient increases self-sufficiency, reduces prosociality.

- **Support.** Early experiments found robust "money priming" effects (Vohs, Mead, & Goode, 2006), though large-scale replications suggest mixed reliability of some social-priming phenomena (Camerer et al., 2018).
  (Vohs et al., 2006; Camerer et al., 2018).

M5. Neural overlap: secondary (monetary) rewards co-opt primary reward systems (N↔C)

- **Claim.** Monetary cues recruit valuation circuits tuned for primary rewards, making symbol-chasing feel compelling while increasing energetic load under chronic uncertainty.

- **Support.** Meta-analysis: human striatum processes both primary (food/sex) and secondary (money) rewards in overlapping networks (Sescousse, Caldú, Segura, & Dreher, 2013).
(Sescousse et al., 2013).

M6. Markets can also discipline fairness (E→C)

- **Counter-evidence.** Cross-cultural experiments show **market integration correlates with fairer offers and stronger punishment of unfairness**—i.e., institutions can *embed* fairness (Henrich et al., 2010).
(Henrich et al., 2010).

Interim verdict. Money is not inherently corrosive; its **design and embedding** matter. When metrics detach from reality and incentives signal self-interest alone, distortions proliferate. When institutions re-embed prices in real constraints and norms, markets can scaffold fairness and cooperation.

4.13.2 NiCE synthesis: how the Trojan Horse works (and how to defang it)

- **E → C:** Metricized, abstract monetary environments increase salience of symbolic payoffs; market framings may normalize trade-offs that people otherwise reject (Falk & Szech, 2013). Goodhart effects push agents to optimize the measure, not the mission (Strathern, 1997; Muller, 2018).

- **C → N:** Heightened vigilance for symbolic status/returns taxes self-regulation and fuels stress; moral disengagement and rumination raise energetic costs.

- **N → C/E:** Fatigue and stress (high α in your active-inference cost term) bias toward short-horizon, low-effort policies (scrolling, speculation), further entrenching E-level architectures that reward appearance over repair.

But: E can also **fortify** C and N when prices/metrics are tied to real outcomes and autonomy/competence are respected (Henrich et al., 2010; Bowles & Polanía-Reyes, 2012).

4.13.3 Cultural corroboration (contemporary & historical)

- **Philosophy & political economy.** Simmel's and Zelizer's analyses highlight money's plastic social meanings; Polanyi warns that disembedding markets from social/natural constraints destabilizes society (Simmel, 1978/1900; Zelizer, 1994; Polanyi, 1944).

- **Modern critiques of metric fixation.** "Tyranny of metrics" documents how targets corrupt the mission (Muller, 2018).

- **Popular media as cultural diagnostics.** *The Wolf of Wall Street* (Scorsese, 2013) dramatizes symbol-chasing and moral disengagement; *Death of a Salesman* (Miller, 1949) portrays the psychic toll of status-denominated success.

4.13.4 Testable predictions & study designs (falsifiable)

Resource re-embedding reduces drift (E×C).

- **Design:** Cluster RCT in organizations comparing **standard monetary KPIs** vs **resource-indexed KPIs** (e.g., per-unit energy/carbon, repair rates) × **mastery-feedback** vs **rank dashboards**.
- **Outcomes:** Prosocial behavior, cheating, mission-aligned innovation, physiological stress in sub-samples.
- **Expectation:** Resource-indexed + mastery reduces cheating and burnout, increases real-world outcomes (RE-AIM).

Market framing vs. civic framing (E).

- **Design:** Lab markets with moral stakes vs non-market allocation with deliberation; pre-registered harm-acceptance thresholds.
- **Expectation:** Replicate/qualify Falk & Szech (2013): market framing raises harm acceptance; civic deliberation attenuates it.

Incentive architecture (E×C): crowd-out vs crowd-in boundary conditions.

- **Design:** 2×2: **payment (none/small/adequate)** × **signal (trust/autonomy vs surveillance)** for prosocial tasks (teaching/helping).
- **Expectation:** Small controlling payments crowd out (Deci et al., 1999; Gneezy & Rustichini, 2000a,b; Bowles & Polanía-Reyes, 2012). Trust-signaled payments crowd **in**.

Neural/physiological coupling (N×C).

- **Design:** fMRI/psychophysiology while subjects pursue **money-only** vs **resource-real** incentives; measure striatal responses, HRV, and persistence under uncertainty.
- **Expectation:** Overlap in reward circuits (Sescousse et al., 2013) but improved regulation and persistence when incentives are resource-real and mastery-based.

External validity of "money priming" (E→C).

- **Design:** High-power, pre-registered replications in field contexts; report nulls per open-science norms.

- **Expectation:** Mixed effects consistent with replicability audits (Camerer et al., 2018); effects likely contingent on framing and stakes.

4.13.5 Design principles (NiCE-aligned correctives)

1. **Re-embed metrics in reality (E).** Tie payouts to **physical outcomes** (e.g., carbon/energy-indexed dividends; repair rates) and publish error bounds to blunt Goodhart drift (Strathern, 1997; Muller, 2018).

2. **Protect intrinsic motives (C).** Use **mastery/competence feedback** and autonomy-supportive controls to avoid crowd-out (Deci et al., 1999; Bowles & Polanía-Reyes, 2012).

3. **Mind the human energy budget (N).** Cap harmful pacing; reduce ambiguity; design recovery windows to keep α (energy sensitivity) low enough for long-horizon work.

4. **Institutional guardrails (E).** Audit incentive schemes for distributional effects and moral externalities (Frey & Oberholzer-Gee, 1997; Bowles, 2008).

4.13.6 Summary

Money is an extraordinarily powerful coordination technology. It **can** act as a Trojan Horse when **metrics detach from missions** and **incentives detach from real substrates**—crowding out intrinsic motives and normalizing harmful trade-offs. But the same tool can **discipline fairness** and **amplify stewardship** when **embedded in ecological constraints** and **aligned with human natural incentives** (autonomy, mastery, belonging).

In environments where monetary symbols are weakly coupled to real outcomes and mastery, money behaves like a Trojan Horse—subtly and gradually enough to escape effective attention, but with remarkable effects, it strongly appears to consistently repattern cognition and norms toward symbolic extraction and away from 'best-interest' stewardship. With such powerful corrupting tendencies seemingly baked in, can the very same technology be rehabilitated? If metrics are embedded in ecological substrates and incentive architectures to protect autonomy and competence, markets can **amplify** fairness and long-horizon value creation rather than irrationalize it (Henrich et al., 2010; Bowles & Polanía-Reyes, 2012; Strathern, 1997; Muller, 2018).

We believe the evidence strongly suggests this is a simple matter of natural incentives. When economic activity remains directly tethered to ecological resources—calories, water, shelter, energy—behavior tends to track biophysical limits and can appear rationally disciplined. But when activity becomes symbolically mediated, circulating primarily through money, metrics, or visibility tokens, the rational tether frays. The system begins to optimize for what is priced rather than what is needed, and drift becomes not just possible but inevitable. This drift cascades where ever it touches, across Nature, Consciousness, and Institutions alike, misdirecting effort toward symbolic yields while the material bases of survival are degraded.

Fairness, once anchored in mutual recognition and shared survival, drifts under symbolic money into an ethic of minimum-constraint opportunism: law instead of justice, compliance instead of ethics, branding instead of democracy, billing instead of care, metrics instead of learning, transactions instead of relationships, networks instead of communities, and extraction instead of stewardship.

Hypothesis

A system in rational balance is one that remains correctively tethered to ecological reality: it respects nature's limits, stabilizes population within sustainable bounds, and preserves the environmental conditions that sustain life. Such a system upholds justice and fairness not as symbolic veneers but as lived commitments, ensuring that basic human needs—food, water, shelter, health, education—remain affordable and accessible. In this equilibrium, respect for life, stewardship of resources, and the durability of shared institutions reinforce one another, aligning survival with dignity.

- **Nature (N):** A rationally balanced system respects ecological limits, stabilizes population within carrying capacity, and safeguards the biophysical conditions—climate, water, soil, biodiversity—that sustain life.

- **Consciousness (C):** It anchors human motives in fairness, respect for life, and stewardship, cultivating aspirations that prize durable well-being over symbolic gains.

- **Environment/Institutions (E):** It maintains justice as more than legalism, ensures affordability and accessibility of basic needs, and structures markets and governance so that essential provisioning is rewarded above spectacle or extraction.

While no system can ever be perfectly balanced, our aim is *a rational, mechanical framework for understanding, analysis, and diagnosis*—a lens through which we can *better evaluate what is in our best interest.* Working principles serve not as utopian blueprints but as guides for steady, directional progress. Within this framework, the components of the NiCE triad reinforce one another: survival and dignity align, stewardship strengthens resilience, and the system remains tethered to ecological and social reality rather than drifting into self-referential symbolic disarray.

Table 21 – Litmus test for how Symbolic Drift Degrades Core Social Functions

Anchored in Fairness & Survival	Degraded Under Symbolic Drift
Justice systems grounded in justice	Justice systems reduced to mere legal systems (compliance with rules over pursuit of justice)
Ethics as moral responsibility	Ethics reduced to compliance (box-ticking rather than genuine responsibility)
Democracy as collective self-rule	Democracy reduced to branding (visibility and narrative dominance over deliberation)
Education as cultivation of knowledge and capacity	Education reduced to credentialing (status tokens and rankings over real learning)
Healthcare as embodied care	Healthcare reduced to billing (codes, reimbursements, throughput over well-being)

Anchored in Fairness & Survival	Degraded Under Symbolic Drift
Work as service, craft, and stewardship	Work reduced to visibility (performativity and metrics over substance)
Relationships as mutual reciprocity	Relationships reduced to transactions (leverage and exchange over care)
Community as shared trust and place	Community reduced to networks (symbolic affiliations over durable ties)
Stewardship of natural systems	Stewardship reduced to extraction (short-term yield, sustainability as branding)

When fairness begins to resemble *not* the pursuit of collective best interest but the promotion of narcissistic sociopathy—defined as "whatever one can get away with while still living comfortably with oneself"—it serves as a clear litmus test that the system has drifted out of natural harmony.

4.14 NiCE diagnosis of systemic irrationalization

Thesis.

Money coordinates complex exchange, yet it bears no direct tie to survival (unlike calories, water, shelter). As money expands into an abstract, self-referential signal, it increasingly warps valuation—elevating symbolic attention and positional gains over practices that secure durable wellbeing. In NiCE terms, monetary signals that decouple from Nature's budgets (N), distort Consciousness and motivation (C), and misalign Environment/Institutional rules (E) create reinforcing feedbacks that reward spectacle and short-term extraction over provisioning, stewardship, and long-horizon care.

4.14.1 Consciousness (C): why symbolic money can overshadow material reality

Money as secondary reward and "drug-like" incentive. Neuroeconomic and behavioral evidence shows money acts as a generalized conditioned reinforcer ("tool and drug"): it acquires incentive salience similar to primary rewards via associative learning, robustly recruiting dopaminergic reward circuits (ventral striatum) during anticipation/outcome of monetary gains (Lea & Webley, 2006; Sescousse, Caldú, Segura, & Dreher, 2013). In plain terms, brains learn to treat currency as if it were inherently valuable, *even though a starving lion—tuned to primary rewards—would ignore it.*

Crowding-out of prosocial motives.

Priming people with money reduces helping, increases social distance, and heightens self-sufficiency (Vohs, Mead, & Goode, 2006). Market framings can lower moral restraint (Falk & Szech, 2013), while poorly designed extrinsic rewards undermine intrinsic motivation—precisely the motive structure that sustains caregiving, education, and craft quality (Deci, Koestner, & Ryan, 1999; Gneezy & Rustichini, 2000a, 2000b).

Status orientation and well-being.

Cultural psychology finds materialistic/status values correlate with lower well-being and weaker sustainability behaviors (Dittmar, Bond, Hurst, & Kasser, 2014; Isham et al., 2022). In attention markets, metricized visibility (followers, views) becomes a currency, reinforcing self-presentation over service—amplifying the salience of money-like symbolic returns relative to material repair.

Prediction C1

(falsifiable). Organizations/sectors that

(i) frequently prime money/status, and
(ii) compensate narrowly on visibility/short-term metrics will show lower prosocial behavior, higher misconduct/accident rates, and worse long-run quality than matched controls using multi-capital, purpose-compatible incentives.

4.14.2 Nature (N): when prices detach from biophysical reality

Boundary overshoot and distorted costs.

Empirical syntheses indicate humanity has transgressed six of nine planetary boundaries (e.g., climate, biosphere integrity, novel entities), i.e., we are operating outside safe ecological budgets (Richardson et al., 2023). Meanwhile, fossil energy remains heavily underpriced once health and climate damages are counted, sustaining overuse and rent-seeking (Black, Liu, Parry, & Vernon, 2023).

Throughput rarely falls without caps.

With consumption-based accounting, national material footprints typically rise with GDP; robust absolute decoupling is rare without binding constraints (Wiedmann et al., 2015). When prices ignore caps, money signals profitability in activities that erode the stocks that make any economy possible; symbolic gains crowd out material repair.

Prediction N1.

Firms adopting absolute ecological budgets (carbon/water/materials) plus full-cost accounting will show declining total footprints and lower transition risk than peers matched on sector/scale that use intensity-only targets.

4.14.3 Environment/Institutions (E): selection effects and rule-driven drift

Financialization and the allocation of talent.

As returns accrue to symbolic extraction (trading, balance-sheet engineering, attention sales), talent rationally flows there—even when social returns are lower (Baumol, 1990; Murphy, Shleifer, & Vishny, 1991; Krippner, 2005; Philippon, 2015).

Metric fixation.

Institutions over-reward what's easily counted (EPS, engagement, OKRs) and under-reward repair (learning gains, prevention, resilience)—a classic metrics failure (Muller, 2018).

Power and pay structures.

Monopsony and fragmented bargaining in essential sectors suppress wages below marginal product, worsening shortages even as needs rise (Staiger, Spetz, & Phibbs, 2010).

Prediction E1.

Jurisdictions that

(i) broaden fiduciary focus beyond narrow shareholder primacy,
(ii) link access to public capital/procurement to verified repair outcomes, and
(iii) reduce labor market monopsony will show faster remediation, lower vacancy/turnover in essentials, and fewer boundary breaches than peers.

4.14.4 Synthesis: Interdependence and feedbacks (N ↔ C ↔ E)

Changes in any dimension propagate:

- E→C: Tournament/visibility pay (E) reshapes motives (C), raising the salience of symbolic money over material repair.
- C→N: Attention shifts away from stewardship, increasing throughput and degrading stocks (N).
- N→E: As boundaries bite, volatility rises, inviting more short-term financial extraction (E).
- *Without countervailing design, money's abstraction becomes self-referential*: the system leverages signs to chase signs.

4.14.5 What a rational system requires

Budget-first money (N).

Internalize residual harms (pricing/standards), phase out *harmful* subsidies, and bind strategy to absolute ecological budgets with double-materiality risk reporting (Black et al., 2023; Richardson et al., 2023).

Protect intrinsic motives (C).

Replace EPS/visibility-only pay with multi-capital scorecards (well-being, repair, resilience, emissions) and ban "dark patterns." Publish pre-registered KPIs to curb gaming (Deci et al., 1999; Gneezy & Rustichini, 2000a, 2000b).

Polycentric accountability (E).

Co-manage shared resources with monitoring, sanctions, and audit APIs; condition access to public funds and procurement on verified N–C–E improvements (Ostrom, 2009).

System-level prediction.

Portfolios/firms adopting NiCE design will outperform on risk-adjusted durability (fewer regulatory shocks, fewer scandals, steadier margins) while delivering measurable N–C–E gains relative to benchmarks emphasizing symbolic visibility.

5. Conceptual Clarifications

Refining the Triadic Framework

To strengthen the theoretical foundation of our framework and address potential ambiguities, this section provides essential conceptual clarifications. We focus particularly on the nature of the relationships between the three corners of our triad, the integration of different theories of consciousness, and the operationalization of key concepts.

5.1 Levels and Causation: Constitutive, Causal, and Enabling Relations

A central claim of our framework is that human nature, consciousness, and the environment stand in relations of "mutual constitution." To avoid conceptual confusion, we must clarify what we mean by "constitutive" and distinguish it from other types of relations.

Constitutive links fix identity at a time slice: remove the part and the phenomenon ceases to be that phenomenon. Causal links change state across time slices. Enabling links supply boundary conditions: remove them and the phenomenon can, in principle, exist, but not under the here-and-now constraints.

5.1.1 Defining Relationship Types

Constitutive Relations: A constitutive relation exists when one element is part of what makes another element what it is—it partially realizes or defines the identity of the other element (Bennett, 2017). Constitutive relations are synchronic (occurring at the same time) and involve identity rather than causation.

1. **Stress–strain in materials science**

   Stress and strain are not merely correlated; strain *partly constitutes* what stress means in a material body. The relation is definitional in continuum mechanics (Smith, 1993).

2. **Electromagnetic constitutive laws**

   In Maxwell's framework, the displacement field **D** is defined in terms of the electric field **E** and permittivity; this is not causal but constitutive of what the medium is (ETH Zürich, n.d.)

3. **Neural activity and consciousness**

   Certain neural patterns are argued to be *constitutive* of conscious states, not merely causal precursors (e.g., gamma synchrony constituting visual awareness) (Chalmers, 2000).

4. **Causal Relations**:

   A causal relation exists when one element produces a change in another element over time (Woodward, 2003). Causal relations are diachronic (occurring across time) and involve the transfer of energy or information from cause to effect.

Enabling Relations: An enabling relation exists when one element provides the necessary conditions for another element to function or exist, without being either constitutive of it or directly causing it (Craver, 2007). Enabling relations often involve background conditions or capacities.

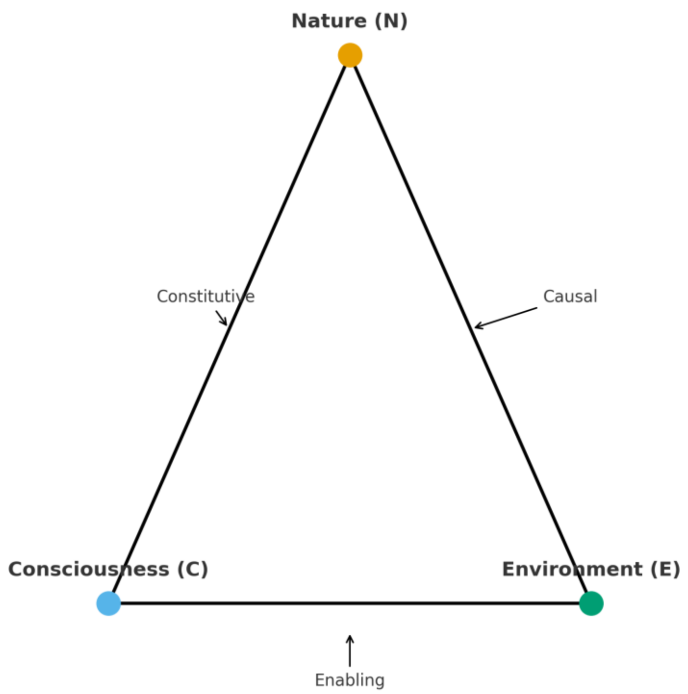


Figure 6 - Triadic Relationships

This figure illustrates the Human Paradigm triadic structure (Nature–Consciousness–Environment), with arrows marking constitutive, causal, and enabling relations.

5.1.2 Case Study: Literacy and Consciousness

This subsection outlines the Literacy and Consciousness Case Study. To illustrate these distinctions, we consider the case of literacy—the ability to read and write:

Constitutive Relation: The neural circuits that process written language are constitutive of the conscious experience of reading. The phenomenal experience of reading is partially realized by these neural processes; they are not separate things but different levels of description of the same phenomenon (Dehaene, 2009).

Causal Relation: Learning to read causes changes in brain structure and function over time, such as the development of the Visual Word Form Area (VWFA) (Dehaene, Cohen, Morais, & Kolinsky, 2015). These changes are diachronic effects of the learning process, not constitutive elements of the ability itself.

Enabling Relation: The evolved capacity for complex pattern recognition enables humans to learn to read, without being either constitutive of literacy or directly causing it (Changizi, & Shimojo, 2005). This capacity provides the necessary background condition for literacy to develop.

5.1.3 Clarifying "Downward Causation"

The concept of "downward causation"—where higher-level phenomena influence lower-level processes—has been controversial in philosophy of science (Kim, 1999). We use this term in a specific sense:

Multi-level Constraint: Higher-level organization (such as conscious goals or institutional rules) constrains lower-level dynamics by narrowing the state-space of possible configurations and channeling flows of energy or information (Juarrero, 1999). This is not a violation of physical causality but a recognition that constraints at one level can shape dynamics at another.

Examples:

- A conscious vow or commitment changes policy priors and attentional gating, influencing which neural pathways are activated in decision-making (Legrand, & Ruby, 2009).
- Cultural rituals stabilize affective control loops by providing predictable patterns that reduce uncertainty and free energy (Hobson, Schroeder, Risen, Xygalatas, & Inzlicht, 2018).
- Linguistic categories shape perceptual processing, influencing how basic sensory information is organized and interpreted (Lupyan, & Clark, 2015).

5.2 Consciousness Theories: A Level-Pluralist Approach

Our framework draws on three major theories of consciousness: Integrated Information Theory (IIT), Global Neuronal Workspace Theory (GNW), and Higher-Order Thought Theory (HOT). Rather than attempting to force these theories into a single unified account, we adopt a "level-pluralist" approach that recognizes their complementary contributions.

5.2.1 Disentangling Theories by Domain

Integrated Information Theory (IIT): IIT addresses the structural and phenomenal organization of consciousness—what makes an experience the specific experience that it is (Tononi et al., 2016). It provides a potential metric for phenomenal consciousness (Φ) based on the integration of information within a system Our ontological commitments are detailed in Section 2.6.

Global Neuronal Workspace Theory (GNW): GNW addresses the functional dynamics of access consciousness—how information becomes available for report, reasoning, and action control (Mashour et al., 2020). It explains the broadcasting of information across specialized brain modules and the serial nature of conscious access.

Higher-Order Thought Theory (HOT): HOT addresses the metacognitive dimension of consciousness—how we become aware of our own mental states (Lau, & Rosenthal, 2011). It explains reflective self-awareness and the ability to monitor and evaluate our own cognitive processes.

5.2.2 Integration Without Reduction

These theories are not trivially compatible, as they make different assumptions and focus on different aspects of consciousness. Rather than attempting to reduce one theory to another, we propose that each theory captures an important aspect of the complex phenomenon we call consciousness:

- IIT captures the intrinsic, phenomenal structure of experience
- GNW captures the functional, access-related dynamics of consciousness
- HOT captures the metacognitive, reflective dimension of consciousness

This level-pluralist approach allows us to draw on the strengths of each theory while acknowledging their limitations and the tensions between them. It also aligns with our broader triadic framework, which emphasizes the multi-faceted nature of human existence.

5.2.3 Implications for the Hard Problem (bridge to methods)

For the ontological account of consciousness as **triadic organization**, see §2.7 (esp. §2.7.3). Here, we focus on *implications for design and measurement*: (i) prioritize experiments that **co-perturb E, N, and C**; (ii) report **constitutive, causal, and enabling** roles explicitly; (iii) stage **preregistered 2×2** pilots (e.g., [illumination/symbols]×[arousal/metacognition]) with RE-AIM outcomes. This aligns the theory with tractable, falsifiable workstreams that connect phenomenology to mechanism and context.

5.3 Operationalizing Key Concepts

To move beyond metaphorical descriptions and enable empirical testing, we need to operationalize key concepts in our framework. Here we focus on two concepts that require particular clarification: "beings in tension" and "the self."

5.3.1 Beings in Tension: Measurable Axes

The concept of "beings in tension" refers to the fundamental paradoxes or polarities that characterize human existence. To make this concept more empirically tractable, we specify several measurable axes along which these tensions manifest:

Exploration–Exploitation: The tension between exploring new possibilities and exploiting known resources (Cohen, McClure, & Yu, 2007). This can be measured through behavioral tasks that assess risk-taking, novelty-seeking, and learning rates.

Autonomy–Relatedness: The tension between individual independence and social connection (Ryan, & Deci, 2000). This can be measured through self-report scales of independence/interdependence and physiological measures of social attunement.

Precision–Flexibility: The tension between maintaining stable beliefs and adapting to new information (Hohwy, 2013). This can be measured through tasks assessing cognitive flexibility, belief updating, and uncertainty tolerance.

These tensions manifest differently across cultures and developmental stages, with cultural parameters (such as tightness/looseness (Gelfand, Raver, Nishii, Leslie, Lun, Lim, &

Yamaguchi, 2011) and neural control mechanisms (such as neuromodulatory balance (Aston-Jones, & Cohen, 2005) influencing where individuals and societies fall along these axes.

5.3.2 The Layered Self: From Minimal to Narrative

The concept of "the self" is central to our framework but requires clarification to avoid confusion. We distinguish between several layers of selfhood, each with different relationships to nature, consciousness, and environment:

Embodied Minimal Self: The basic sense of being a bounded, embodied agent with a first-person perspective (Zahavi, 2005). This layer is closely tied to our evolved nature and appears to be robust across cultural contexts, though its specific manifestations may vary.

Narrative Social Self: The autobiographical self-constructed through storytelling and social interaction (Schechtman, 2011). This layer is heavily shaped by cultural-symbolic resources and varies significantly across cultural contexts.

Temporally Extended Agentic Self: The sense of being an agent that persists through time, capable of making and fulfilling commitments (Bratman, 2000). This layer emerges from the interaction between our evolved capacity for mental time travel and culturally provided temporal frameworks.

Metacognitive Self-Model: The explicit, reflective model we have of our own minds and capabilities (Fleming, & Dolan, 2012). This layer depends on both evolved metacognitive capacities and culturally provided concepts and categories.

These layers are not separate selves but nested levels of organization, each building on and incorporating the previous levels. The minimal self provides the foundation, while the narrative, agentic, and metacognitive layers add increasing levels of complexity and cultural mediation.

By clarifying these concepts and their relationships, we provide a more solid foundation for the empirical investigation of our triadic framework. In the next section, we will build on these clarifications to develop explicit causal models and formalization strategies.

6. Causal Models and Empirical Framework

To move beyond descriptive accounts and enable rigorous empirical testing, this section develops explicit causal models and formalization strategies for our triadic framework. We begin with a multi-level causal graph that captures dynamic interactions among nature (N), consciousness (C), and environment (E). We then propose mathematical formalizations, describe parameter-estimation and identifiability strategies, and lay out a comprehensive measurement plan across N, C, and E. Together, these choices convert a conceptual triad into a program of falsifiable predictions and reproducible analyses (Tenenbaum, Kemp, Griffiths, & Goodman, 2011; Friston, FitzGerald, Rigoli, Schwartenbeck, & Pezzulo, 2017).

6.1 Multi-Level Causal Graph: Dynamic Interactions

Static Venn sketches are helpful for intuition but fail to capture the causal, multi-scale couplings that actually generate behavior and experience. We therefore formalize the triad as a directed, time-indexed graph connecting latent states within and across time slices. Within a time slice, constitutive relations capture structural couplings (e.g., neuromodulatory tone constraining workspace dynamics). Across time slices, causal relations encode how present states shape future states via development, learning, and environmental change (Dehaene & Changeux, 2011).

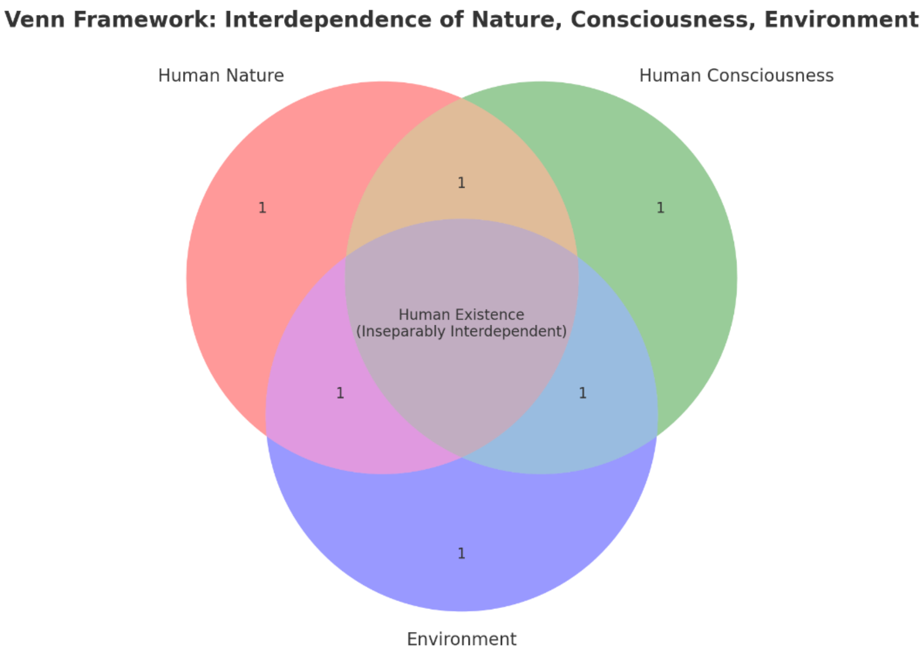


Figure 7 - Basic Venn Framework - NiCE

The static Venn diagrams here, intuits causal interactions between the three corners of our triad. In Figure 8. (below), a more sophisticated causal model explicitly represents these interactions across multiple levels and timescales.

6.1.1 Nodes and Edges

Nodes. Nature (N) includes constraint priors, energy budgets, and plasticity envelopes; Consciousness (C) includes phenomenal fields, global-access / "workspace" dynamics, metacognitive monitoring, and goal-directed control; Environment (E) includes physical affordances, symbolic tools, institutions, and developmental inputs (Donald, 1991).

Edges (mechanisms). **N→C** capacity constraints (working-memory/attention limits); **E→C** task and meaning scaffolds (external memory, cultural concepts); **C→E** policy/design; **E→N** developmental/epigenetic change; **C→N** training-induced plasticity; **N↔E** niche construction (Creanza, Kolodny, & Feldman, 2017).

Nature (N):

- Constraint priors: Evolved capacities that set the boundaries of possible development
- Energy budgets: Metabolic constraints that limit cognitive and behavioral processes
- Plasticity envelope: The range of possible phenotypic expressions given genetic constraints

Consciousness (C):

- Phenomenal fields: The qualitative, subjective dimension of experience
- Access/workspace dynamics: The functional processes that make information globally available
- Metacognitive monitoring: The reflective awareness of one's own mental states
- Goal-directed control: The intentional guidance of attention and action

Environment (E):

- Ecological affordances: The action possibilities provided by the physical environment
- Symbolic tools: Language, art, and other representational systems
- Institutional structures: Social organizations, norms, and roles
- Developmental inputs: Nutrition, caregiving, education, and other formative influences

Edges (Causal Mechanisms):

- $\boldsymbol{N} \rightarrow \boldsymbol{C}$: Capacity constraints (e.g., working memory limits, attentional bottlenecks)
- $\boldsymbol{E} \rightarrow \boldsymbol{C}$: Task and meaning scaffolds (e.g., cultural concepts, external memory systems)
- $\boldsymbol{C} \rightarrow \boldsymbol{E}$: Policy/design (e.g., intentional modification of the environment)
- $\boldsymbol{E} \rightarrow \boldsymbol{N}$: Developmental/epigenetic changes (e.g., nutritional effects on gene expression)
- $\boldsymbol{C} \rightarrow \boldsymbol{N}$: Training-induced plasticity (e.g., expertise development within genetic constraints)
- $\boldsymbol{N} \leftrightarrow \boldsymbol{E}$: Niche construction (e.g., cultural evolution shaping selection pressures)

6.1.2 Temporal Dynamics of the N–C–E Triad

Overview. We distinguish (i) constitutive (within-slice) relations among Nature (**N**), Consciousness (**C**), and Environment (**E**)—what jointly composes the state at time t—from (ii) causal (across-slice) relations that map $[N_t, C_t, E_t]$ to $\left[N_{\{t+1\}}, C_{\{t+1\}}, E_{\{t+1\}}\right]$. The nine directed pathways (1–9) are the entries of a 3×3 mapping across time; they are estimable as parameters of a state update, not merely conceptual (Friston, Harrison, & Penny, 2003; Hamaker, Kuiper, & Grasman, 2015; Masten & Cicchetti, 2010; Seth, Barrett, & Barnett, 2015).

The temporal dynamics of the Human Paradigm reveal how Nature, Consciousness, and Environment interact not only synchronically (within a given moment) but also diachronically (across time). Figure 2 illustrates the nine distinct causal pathways through which each element at time t influences each element at time t+1. These pathways represent specific mechanisms of change that operate across different timescales, from milliseconds to generations, and collectively account for the dynamic evolution of human existence (Oyama et al., 2001; Griffiths & Stotz, 2013).

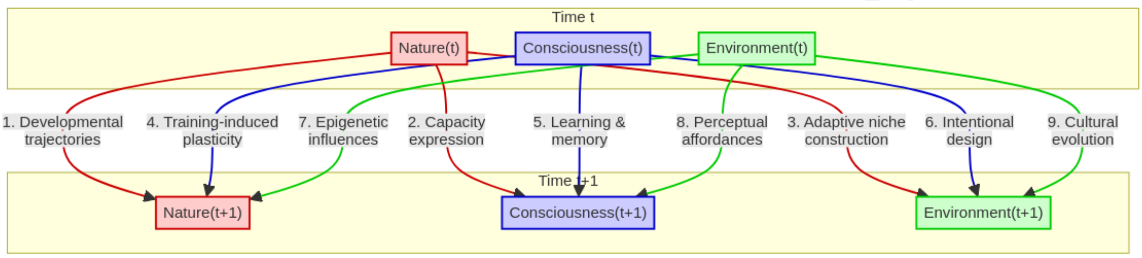


Figure 8 - Multi-level causal graph of Nature–Consciousness–Environment (NiCE) with constitutive (within-slice) and causal (across-slice) connections.

Temporal dynamics of the triadic framework, showing within-time-slice (constitutive) relations and across-time-slice (causal) relations as the system evolves over time. Multi-level causal graph showing the dynamic interactions between nature, consciousness, and environment, with their respective components and the specific mechanisms of interaction between them.

To capture the dynamic nature of these interactions, we must consider how they unfold over time. We can represent this using a time-indexed version of our causal graph, where the state at time $t+1$ depends on the state at time t:

Within-time-slice relations (constitutive):

- $\boldsymbol{N_t} \leftrightarrow \boldsymbol{C_t}$: Nature constrains the possible states of consciousness at any given moment
- $\boldsymbol{E_t} \leftrightarrow \boldsymbol{C_t}$: Environment provides the immediate context for conscious experience
- $\boldsymbol{N_t} \leftrightarrow \boldsymbol{E_t}$: Nature and environment are structurally coupled at each moment

Across-time-slice relations (causal):

- $\boldsymbol{N_t} \rightarrow \boldsymbol{N_{\{t+1\}}}$: Developmental trajectories within plasticity bounds
- $\boldsymbol{C_t} \rightarrow \boldsymbol{C_{\{t+1\}}}$: Learning and memory processes

- $\boldsymbol{E_t} \rightarrow \boldsymbol{E_{\{t+1\}}}$: Environmental changes (both natural and human-caused)
- $\boldsymbol{C_t} \rightarrow \boldsymbol{E_{\{t+1\}}}$: Conscious modification of the environment
- $\boldsymbol{E_t} \rightarrow \boldsymbol{N_{\{t+1\}}}$: Environmental influences on development
- $\boldsymbol{C_t} \rightarrow \boldsymbol{N_{\{t+1\}}}$: Conscious practices that shape neural structure

This temporal representation allows us to distinguish between synchronic (**constitutive**) relations that hold at a single time point and diachronic (**causal**) relations that unfold over time.

Causal Pathways from Nature

Nature's influence on itself across time operates through developmental trajectories (pathway 1), which describe how biological capacities unfold within genetically and epigenetically constrained plasticity bounds (Gottlieb, 2007; Lickliter & Honeycutt, 2003). These trajectories are not rigidly predetermined but represent probabilistic developmental pathways shaped by both intrinsic maturational processes and environmental inputs (Bjorklund, 2015). For instance, the development of language capacity follows a species-typical trajectory, yet the specific neural architecture that emerges depends on the linguistic environment encountered during critical periods (Kuhl, 2004; Werker & Hensch, 2015).

Nature's influence on consciousness manifests through capacity expression (pathway 2), whereby evolved biological capacities enable and constrain the range of possible conscious states (Edelman & Tononi, 2000; Dehaene & Changeux, 2011). The phenomenal character of color experience, for example, is fundamentally shaped by the trichromatic structure of human photoreceptors and the neural processing architecture of the visual system (Gegenfurtner & Kiper, 2003). Similarly, the capacity for episodic memory—the ability to mentally travel in time to re-experience past events—depends on specific neural structures including the hippocampus and prefrontal cortex (Tulving, 2002; Schacter et al., 2007). Changes in these biological substrates, whether through development, injury, or disease, directly alter the landscape of possible conscious experiences (Damasio, 2010).

Nature's influence on environment occurs through adaptive niche construction (pathway 3), the process by which organisms actively modify their surroundings in ways that reflect their biological capacities and needs (Odling-Smee et al., 2003; Laland et al., 2016). Human bipedalism, for instance, freed the hands for tool use and manipulation, fundamentally reshaping the material environment humans create and inhabit (Kivell, 2015). The extended period of human childhood, another biological feature, necessitates stable social structures and cultural transmission systems, thereby shaping the social and symbolic environment (Konner, 2010; Gopnik, 2020).

Causal Pathways from Consciousness

Consciousness's influence on nature operates through training-induced plasticity (pathway 4), whereby repeated conscious practices and experiences reshape neural structures and functions (Draganski et al., 2004; May, 2011). The acquisition of expertise in domains such as music, mathematics, or meditation produces measurable changes in brain structure, including alterations in gray matter volume, white matter connectivity, and patterns of neural activation (Gaser & Schlaug, 2003; Tang et al., 2015). These neuroplastic changes demonstrate that consciousness is not merely an epiphenomenal product of neural activity but actively participates in sculpting its own biological substrate (Merzenich et al., 1996; Pascual-Leone et al., 2005).

Consciousness's influence on itself unfolds through learning and memory (pathway 5), the processes by which conscious experiences at one moment shape the content and structure of consciousness at subsequent moments (Squire & Dede, 2015; Dudai et al., 2015). This pathway encompasses not only explicit learning of facts and skills but also implicit learning of associations, habits, and emotional responses (Henke, 2010). The narrative self, a central feature of human consciousness, is continuously constructed and reconstructed through memory processes that selectively encode, consolidate, and retrieve past experiences in ways that maintain a coherent sense of personal identity across time (Conway & Pleydell-Pearce, 2000; McAdams & McLean, 2013).

Consciousness's influence on environment manifests through intentional design (pathway 6), the deliberate modification of the environment to serve consciously represented goals and values (Clark, 2008; Sterelny, 2012). Unlike the more automatic niche construction driven by biological needs, intentional design reflects uniquely human capacities for prospective thinking, symbolic representation, and collective intentionality (Tomasello et al., 2005; Suddendorf et al., 2009). The built environment—from simple tools to complex cities—embodies conscious intentions and cultural meanings, creating a material and symbolic landscape that both reflects and shapes human consciousness (Norman, 1988; Renfrew & Scarre, 1998).

Causal Pathways from Environment

Environment's influence on nature occurs through epigenetic influences (pathway 7), whereby environmental factors modulate gene expression without altering the underlying DNA sequence (Jablonka & Raz, 2009; Meaney, 2010). Nutritional factors, stress exposure, social experiences, and cultural practices can all induce epigenetic modifications that alter phenotypic outcomes and, in some cases, can be transmitted across generations (Champagne & Mashoodh, 2009; Dias & Ressler, 2014). These mechanisms provide a molecular bridge between environmental and biological levels, demonstrating that the boundary between nature and nurture is far more permeable than traditionally assumed (Zhang & Meaney, 2010; Lester et al., 2016).

Environment's influence on consciousness operates through perceptual affordances (pathway 8), the action possibilities and meanings that environmental structures present to conscious agents (Gibson, 1979; Chemero, 2003). The environment is not experienced as a neutral collection of physical properties but as a meaningful landscape of opportunities and constraints for action (Rietveld & Kiverstein, 2014). A chair affords sitting, a staircase affords climbing, and a written text affords reading—but only for agents with the appropriate bodily capacities and cultural competencies (Heft, 2001; Withagen et al., 2012). These affordances shape the content of conscious experience, directing attention, structuring perception, and constraining the range of possible actions and interpretations (Bruineberg & Rietveld, 2014).

Environment's influence on itself unfolds through cultural evolution (pathway 9), the process by which environmental structures—particularly symbolic and institutional structures—change over time through mechanisms of variation, selection, and transmission that parallel but differ from biological evolution (Richerson & Boyd, 2005; Mesoudi, 2011). Languages evolve, technologies accumulate, institutions adapt, and cultural practices spread or disappear based on their functional consequences and their fit with existing cultural systems (Henrich, 2015; Muthukrishna & Henrich, 2016). This evolutionary process operates on timescales ranging from years to millennia and creates an ever-changing environmental context that shapes both biological and conscious dimensions of human existence (Boyd & Richerson, 1985; Laland et al., 2015).

Integration and Implications

These nine causal pathways do not operate in isolation but interact in complex, reciprocal ways to produce the dynamic patterns of human development, learning, and cultural change (Thelen & Smith, 1994; Spencer et al., 2009). A child learning to read, for instance, involves capacity expression (pathway 2) as biological language capacities enable phonological processing (Dehaene, 2009), training-induced plasticity (pathway 4) as reading practice reshapes visual and language areas of the brain (Dehaene et al., 2015), learning and memory (pathway 5) as reading skills accumulate over time (Perfetti & Stafura, 2014), and perceptual affordances (pathway 8) as written symbols come to be experienced as meaningful linguistic units rather than mere visual patterns (Rayner et al., 2012).

The temporal dynamics framework thus reveals the Human Paradigm as a fundamentally processual and evolving system rather than a static structure (Overton, 2015). At any given moment, the three corners of the triad mutually constitute each other through synchronic relations, but across time, each corner actively shapes the future states of all three corners through specific causal mechanisms. This perspective has important implications for understanding human development, education, clinical intervention, and social change, as it highlights the multiple leverage points through which the system can be influenced and the complex feedback loops through which interventions propagate across biological, conscious, and environmental levels (Witherington, 2007; Lerner et al., 2015).

Understanding these temporal dynamics also clarifies the relationship between constitutive and causal explanations in the human sciences (Craver, 2007; Bechtel, 2008). Constitutive relations answer questions about what something is at a given moment (e.g., "What is consciousness?"), while causal relations answer questions about how something changes over time (e.g., "How does consciousness develop?"). Both types of explanation are necessary for a complete understanding of the Human Paradigm, and the framework presented here provides a systematic way of integrating them within a unified theoretical structure (Machamer et al., 2000; Glennan, 2017).

Making "constitutive vs. causal" operational

Compact formalization. Constitutive (within-slice) structure constrains how components co-instantiate at time t; causal (across-slice) dynamics specify directed updates.

$$\text{Let } x_t \equiv [N_t, C_t, E_t]^T.$$

This gathers Nature (N_t), Consciousness (C_t), and Environment (E_t) into a single, analyzable state at time t. It is purely organizational: instead of talking about three moving parts informally, we bind them into a vector $\mathbf{x}_t$so we can write compact models, take derivatives, estimate parameters, and compute predictions. Nothing probabilistic is assumed yet—this is just the bookkeeping that lets the rest of the framework become mathematically explicit.

Once the triad is a vector, we can plug it into standard tools: state-space models, dynamic SEM, DCM, DBNs, cross-lagged panels, or simulators. It also makes "cross-domain" effects concrete: any influence of N_t on C_{t+1} or E_{t+1} becomes just an off-diagonal element of a mapping from $\mathbf{x}_t$ to $\mathbf{x}_{t+1}$. This simple packaging is what turns conceptual arrows into estimable coefficients.

The vectorization assumes that, at a given temporal resolution, each component can be represented by a (possibly multivariate) summary. We retain freedom to make N_t, C_t, or E_t high-dimensional internally (e.g., latent factors), while keeping a single top-level interface $\mathbf{x}_t$ for the dynamics.

Table 22 - Making "constitutive vs. causal" operational Components

Symbol / Term	Plain-language meaning	Rationale for inclusion
x_t	State vector at time t	Collects N, C, and E into one estimable object
N_t	Nature (biology/physiology)	Carries biological constraints forward
C_t	Consciousness/policy/access	Places agentic selection into the same formal state
E_t	Environment/affordances/institutions	Captures scaffolds that constrain and are shaped by the agent

Constitutive (Within-Slice) Structure

$$x_t = C(\Sigma_t)$$

At time t, the triplet $\mathbf{x}_t = [N_t, C_t, E_t]^\top$ is **constructed by** a mapping $\mathcal{C}$ from a set of contemporaneous parameters Σ_t. Instead of saying the state is drawn from a distribution parameterized by Σ_t, we're suggesting the **rules encoded in** Σ_t (e.g., factor loadings, architectural/compatibility constraints, algebraic relations) **determine** a unique admissible configuration of N_t, C_t, E_t. In plain terms: Σ_t encodes *how things must fit together right now*, and $\mathcal{C}$ turns those rules into the actual instantaneous state.

Framing constitution as $\mathbf{x}_t = \mathcal{C}(\Sigma_t)$ makes it crystal clear that **within-slice relations are not causes across time**. They are **co-instantiation rules**—the factorization/compatibility structure that holds at t. This prevents a common inferential error (treating strong contemporaneous association as evidence of temporal causation). Practically, the workflow becomes two-stage: (1) **estimate** Σ_t (e.g., via SEM with equality/inequality constraints, sparse/low-rank structure, or other contemporaneous mapping fits), then **evaluate** $\mathcal{C}$ to obtain $\mathbf{x}_t$; (2) feed $\mathbf{x}_t$ into our **dynamic model** for across-time inference. In figures, the dashed "constitutive" box corresponds to $\mathcal{C}(\Sigma_t)$: it **populates the state at** t, while directed edges depict **changes to** $t + 1$. The approach also supports diagnostics like **model-implied moment checks** and **measurement invariance** of $\mathcal{C}$ across tasks/contexts.

This equality form encodes a **mechanistic** stance appropriate when the instantaneous organization is tightly constrained—by biology (e.g., energetics/precision trade-offs), architecture (access/control coupling), or institutions/affordances—so that once Σ_t is fixed, there is little residual arbitrariness in $\mathbf{x}_t$. It **deconfounds** estimation: constitutive parameters (Σ_t) explain **within-time covariance/compatibility**, while dynamic parameters (in the $t \to t+1$ equation) explain **change**. That separation improves **identifiability** because constitution and causation are not forced to soak up the same variance. If needed, we can soften the mapping with a tiny tolerance term—e.g., $\mathbf{x}_t = \mathcal{C}(\Sigma_t) + \delta_t$ to capture micro-fluctuations—or push noise into a **measurement layer** $\mathbf{y}_t = M(\mathbf{x}_t) + \eta_t$ while keeping constitution noise-free. Requiring $\mathcal{C}$ to be **differentiable** in Σ_t further allows **sensitivity analysis** and coupling to the Jacobian of the dynamics, so small changes in constitutive rules propagate predictably into cross-time effects.

Table 23 - Constitutive (Within-Slice) Structure Components

Symbol / Term	Plain-language meaning	Rationale for inclusion
$\mathcal{C}(\cdot)$	Constitutive mapping or operator (e.g., stress–strain law, covariance structure, factor model).	Encodes the within-slice structural relation that links state variables to parameters.
Σ_t	Parameters at time t (e.g., covariance matrix, stress tensor, structural coefficients).	Provides the contemporaneous structure governing co-variation or response at that time.
x_t	State vector at time t.	The observable or modeled state produced by applying the constitutive mapping to Σ_t.

Causal (Across-Slice) Dynamics

$$x_{\{t+1\}} = f(x_t, u_t) + \varepsilon_t$$

This is the engine of change. Tomorrow's state $\mathbf{x}_{t+1}$ is a (possibly nonlinear) function of today's state $\mathbf{x}_t$ and any exogenous inputs $\mathbf{u}_t$ (instructions, sleep/nutrition manipulation, policy change), plus a noise term $\boldsymbol{\varepsilon}_t$ for unmodeled shocks. It's the umbrella that can encompass learning, depletion, design, and niche construction in one equation.

Because $\mathbf{u}_t$ is explicit, we can perform intervention-based identification: if we randomize sleep or add a scaffold/tool, its effect on specific components of $\mathbf{x}_{t+1}$ is estimable. This is where we recover *directionality* (e.g., whether training in C_t yields plasticity in N_{t+1}) rather than mere correlation.

We assume a Markovian step at our chosen timescale and that unmodeled influences are captured by $\boldsymbol{\varepsilon}_t$. That's standard in state-space work and can be relaxed by adding lags or hierarchical structure if needed.

Table 24 - Causal (Across-Slice) Dynamics Components

Symbol / Term	Plain-language meaning	Rationale for inclusion
$x_{\{t+1\}}$	Next time-step state	Target of prediction/causal inference

Symbol / Term	Plain-language meaning	Rationale for inclusion
$f(\cdot)$	Update function	Encodes learning, depletion, design
u_t	Exogenous inputs	Adds causal leverage (interventions)
ε_t	Process noise	Accounts for stochasticity

with block-Jacobian J capturing directed partial effects from x_t to $x_{\{t+1\}}$.

Block-Jacobian (Directed Partial Effects)

$$J = \frac{\partial f}{\partial x_t}$$

The Jacobian J is the matrix of partial derivatives telling us how a small change in each component of $\mathbf{x}_t$ moves each component of $\mathbf{x}_{t+1}$. Diagonal entries encode within-domain carry-over (e.g., $N_t \to N_{t+1}$), while off-diagonal entries encode cross-domain arrows (e.g., $C_t \to N_{t+1}$, $E_t \to C_{t+1}$, etc.). Our conceptual "nine pathways" are exactly the nine blocks of J.

This gives us a *parameterization* of the diagram. Testing whether a pathway exists is testing whether the corresponding entry in J (or its nonlinear analogue) is non-zero. We can estimate these entries with DCM (neural effective connectivity), Granger/Directed FC (time-series predictive influence), DBNs (graphical time dependence), or RI-CLPM (within-person cross-lagged effects in panels). Edge thickness in our figure maps directly to the magnitude of these entries.

The derivative perspective aligns perfectly with model comparison and sensitivity analysis. It also scales: we can linearize a nonlinear **f** around operating points, or estimate nonparametric analogues (e.g., generalized additive dynamics) and still report local derivatives as "edge strengths."

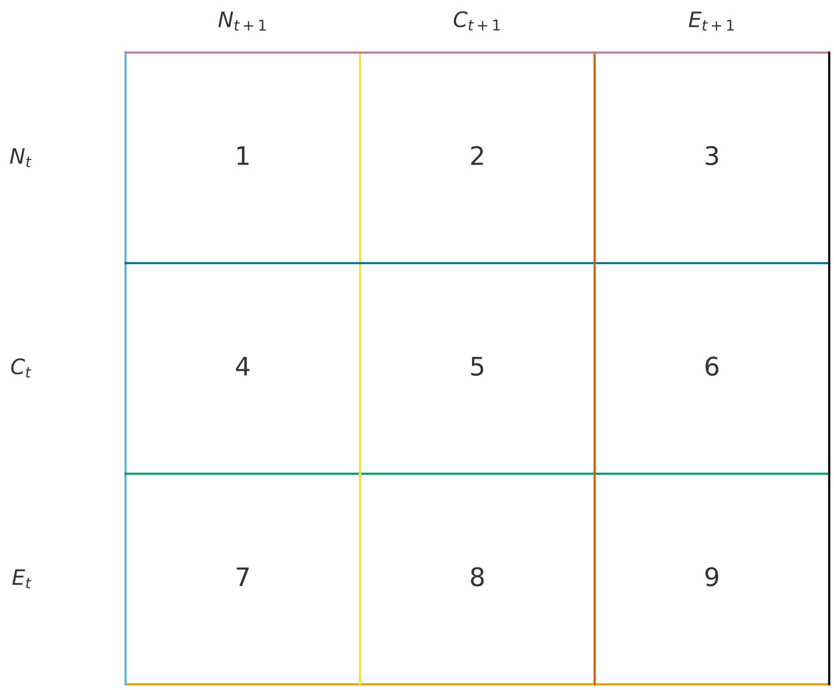


Figure 9 - Shows the conceptual 3×3 with pathway numbers. Conceptual 3×3 mapping from $[\boldsymbol{N_t, C_t, E_t}]\boldsymbol{to}\ [\boldsymbol{N_{t+1}, C_{t+1}, E_{t+1}}]$

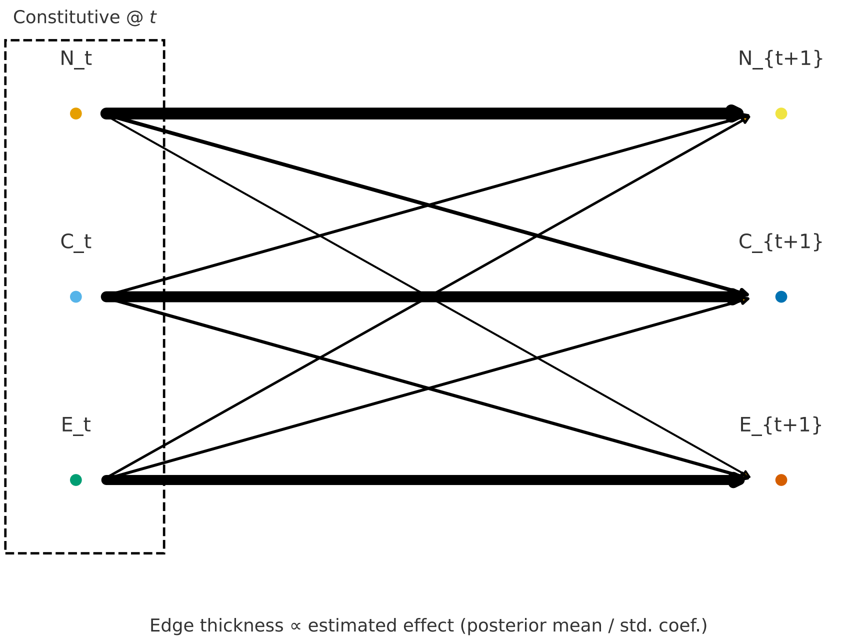


Figure 10 - The same graph as in **Error! Reference source not found.**, rendered with **edge thickness** ∝ **estimated effect** (posterior mean or standardized coefficient) from a

demonstration dataset. **Solid directed edges** depict causal (across-slice) influences; the **dashed rectangle** marks **constitutive (within-slice)** structure at time t.

Note: Entries correspond to partial derivatives in $J = \frac{\partial f}{\partial x_t}$ (or nonlinear analogues); thickness reflects posterior means; the dashed region indicates constitutive covariance at t.

Diagonal entries encode within-domain carry-overs (1, 5, 9); off-diagonals encode cross-domain pathways (2, 3, 4, 6, 7, 8). In practice, entries of J (or nonlinear analogues) are estimable with Dynamic Causal Modeling (Friston et al., 2003, 2019), Granger/Directed FC (Seth et al., 2015), Dynamic Bayesian Networks (Eldawlatly, Jin, & Oweiss, 2010; Burge et al., 2007), and Random-Intercept Cross-Lagged Panel Models (Hamaker et al., 2015; Mulder & Hamaker, 2021).

Bridge to AIF. At each t, policies π_t minimize expected free energy $G_{t(\pi)}$ under an energetic prior $P(\pi) \propto \exp\{-\alpha \cdot E[C]\}$. The nine pathways update the generative parameters θ_t and cost map C_t across time (e.g., training reduces per-action cost; sleep/nutrition shift energetic sensitivity), thereby reshaping the EFE landscape on which policy selection operates (Aston-Jones & Cohen, 2005; Dehaene & Changeux, 2011).

Expected Free Energy

$$G_{t(\pi)} = E_{\{Q(o|\pi)\}}[-\ln P(o)] + E_{\{Q(s|\pi)\}}\big[H\big(P(o|s)\big)\big] + \alpha\, E_{\{Q(s|\pi)\}}[C(\pi, s)]$$

This is the *score* our agent minimizes to choose a policy πat time t. It has three parts:

(1) an **extrinsic** term that penalizes predicted outcomes that deviate from preferences ($-\ln\ P(o)$ under $Q(o \mid \pi)$);

(2) an **epistemic** term that rewards policies expected to reduce uncertainty (lowers ambiguity via the entropy of $P(o \mid s)$); and

(3) an explicit **energetic** term—the expected cost of executing πin likely states—scaled by the sensitivity parameter α.

Putting all three in one objective makes the trade-offs explicit: a policy can be goal-compatible yet too costly; it can be informative but wasteful; or it can be cheap but unhelpful. Because each component is interpretable, we can align them with data: performance/choices for the extrinsic part, exploration/RT/pupil-volatility for the epistemic part, and physiological/effort proxies (pupil/CMR, EMG, subjective effort) for the energetic part. This is where our sleep/nutrition manipulations change behavior in a *diagnostic* way: they shift $\alpha$and the cost map, moving the regimes where different policies are preferred.

The decomposition assumes the agent has a generative model that can form $Q(o \mid \pi)$and $Q(s \mid \pi)$. The cost term being explicit (rather than hidden in preferences) is a principled choice that yields testable signatures (e.g., shifting policy boundaries with αat fixed precision).

Table 25 - Expected Free Energy - Active Inference Bridge Components

Symbol / Term	Plain-language meaning	Rationale for inclusion
$G_{t(\pi)}$	Expected free energy of policy π	Unifies goals, information, energy
$E_{\{Q(o\ \pi)\}}[-\ln P(o)]$	Expected risk	Drives goal-directed selection
$E_{\{Q(s\ \pi)\}}[H(P(o\ s))]$	Expected ambiguity	Encourages epistemic actions
$C(\pi, s)$	Cost of executing π in state s	Makes energy/effort explicit
α	Sensitivity to cost	Separates cost magnitude from weight

Policy Prior

$$P(\pi) \propto \exp\{-\alpha\ E_{\{Q(S|\pi)\}}[C(\pi, s)]\}$$

This defines a *prior* over policies: even before considering rewards or information, high-cost policies are less likely, and low-cost policies are favored—smoothly, via a Boltzmann form. The same αappears here as in the EFE, linking trait- or state-level energetic sensitivity to both prior bias and decision costs.

This prior explains systematic shifts in choice under metabolic manipulation without needing to change "goals." After sleep loss or low glucose (higher α), the model predicts a tilt toward energy-saving policies; after caffeine/glucose (lower α), the model predicts greater willingness to select information-rich or effortful policies. Importantly, this yields *distinctive* model behaviors compared with merely changing softmax precision: α moves regime boundaries (which policy wins), while precision mainly sharpens slopes.

Using a policy-level prior keeps costs conceptually separate from outcome preferences, matching biological common sense (we can value the same goals but become more cost-averse). It also supports Bayesian estimation (priors + likelihoods) and clean parameter recovery from behavior + physiology.

Table 26 - Policy Prior Components

Symbol / Term	Plain-language meaning	Rationale for inclusion
$P(\pi)$	Prior preference over policies	Encodes habitual/trait biases
$\propto \exp\{\cdot\}$	Boltzmann-style prior	Prefers lower-cost policies smoothly
$-\alpha\ E[C(\pi, s)]$	Negative expected energetic cost	Implements energetic prior

Putting it together (why the split matters)

Constitutive vs. causal.

By modeling within-time structure (Σ_t) separately from across-time dynamics ($\mathbf{f}, J$), we prevent constitutive covariation from masquerading as causation. Our "nine pathways" are *parameters* of J, not arm-wavy arrows.

Causality vs. choice.
The dynamics say how the world/agent changes; the AIF piece says how the agent *chooses* in that world. The bridge is crucial: the nine pathways reshape the generative parameters θ_t and cost map C_t, which changes the EFE landscape and thus policy selection—giving us falsifiable predictions for both behavior and physiology.

Measurement strategy.
Estimate Σ_t(CFA/SEM), estimate J(DCM/Granger/DBN/RI-CLPM), and fit the AIF parameters (α, cost map, precision) from choices plus pupil/effort proxies. Convergent fits across these layers is the core empirical payoff of our framework.

Table 27 - Quick Variable Index

Category	**Variables**
States	$N_t, C_t, E_t;\ x_t$
Within-time	Σ_t
Dynamics	$f(\cdot), u_t, \varepsilon_t, J$
AIF	$\pi, G_{t(\pi)}, Q(o\pi), P(o), P(os), H(\cdot), C(\pi, s), \alpha, P(\pi)$

Temporal Scale

A potential misunderstanding is that our framework requires synchronous timescales across N, C, and E. On the contrary, rate-mismatch is central:

Nature (N): slow (decades–millennia)

Consciousness (C): immediate (seconds–years)

Environment (E): fast (days–decades)

Constitutive, causal, and enabling relations operate across asynchronous tempos, generating both frictions (maladaptations) and possibilities (cultural innovation). This disequilibrium is the very condition of human existence.

Table 28 - Pathways, typical timescales, and measurable proxies

Path	Mechanism (source → target)	Typical timescale	Example proxies (operational)

1 $N_t \rightarrow N_{\{t+1\}}$	Developmental/physiological carry-over	months–years	growth curves; neurodevelopmental markers
2 $N_t \rightarrow C_{\{t+1\}}$	Capacity expression	ms–s	psychophysics; P3b/ "ignition" (Dehaene & Changeux, 2011)
3 $N_t \rightarrow E_{\{t+1\}}$	(Unplanned) niche construction	years–centuries	artifact density; settlement data (Odling-Smee et al., 2003; Scott-Phillips et al., 2014)
4 $C_t \rightarrow N_{\{t+1\}}$	Training-induced plasticity	weeks–months	structural/functional MRI; learning curves
5 $C_t \rightarrow C_{\{t+1\}}$	Learning/memory	s–years	retention; consolidation signatures
6 $C_t \rightarrow E_{\{t+1\}}$	Intentional design (tools/institutions)	days–decades	tool metrics; institutional change logs
7 $E_t \rightarrow N_{\{t+1\}}$	Endocrine/epigenetic modulation	weeks–generations	methylation/endocrine panels (Heijmans et al., 2008; Tobi et al., 2009)
8 $E_t \rightarrow C_{\{t+1\}}$	Affordances shaping perception/policy	ms–s	gaze/pupil; action priming; LC–NE pupil indices (Aston-Jones & Cohen, 2005)
9 $E_t \rightarrow E_{\{t+1\}}$	Cultural evolution/diffusion	years–millennia	diffusion curves; diachronic corpora (Odling-Smee et al., 2003)

Estimation/identification routes (from data to the nine arrows)

• Dynamic Causal Modeling (DCM) for effective connectivity with known inputs; Bayesian inversion/model selection yields directed coupling estimates (entries of J) (Friston et al., 2003, 2019; cf. Lohmann, Erfurth, Müller, & Turner, 2012).

• Granger causality / directed functional connectivity for well-sampled neural time series; standard cautions re: filtering/latencies (Seth, Barrett, & Barnett, 2015; Stokes & Purdon, 2017; Barnett, Barrett, & Seth, 2018).

• Dynamic Bayesian Networks (DBNs) for multivariate time series; useful on shorter series and non-Gaussian regimes (Eldawlatly, Jin, & Oweiss, 2010; Burge, Lane, Link, Qiu, & Mathews, 2007; Bielza & Larrañaga, 2014).

• Cross-lagged panel models: Prefer Random-Intercept CLPM to separate within-person dynamics (causal candidates) from between-person constitution/selection (Hamaker, Kuiper, & Grasman, 2015; Mulder & Hamaker, 2021; Sorjonen & Melin, 2023).

• Causal anchors/instruments: Mendelian Randomization for quasi-experimental leverage in **E→N** or **N→C** (Davey Smith & Ebrahim, 2003; Lawlor, Harbord, Sterne, Timpson, & Davey Smith, 2008).

• Natural experiments: e.g., famine cohorts for **E→N** epigenetic/endocrine pathways (Heijmans et al., 2008; Tobi et al., 2009).

6.1.3 Cautions and scope conditions

Epigenetics (**E→N**). Strong in model organisms; in humans cross-generational claims remain provisional. Use famine/natural-experiment cohorts with sibling controls; treat effects as testable, not assumed (Heijmans et al., 2008; Tobi et al., 2009; Cheng et al., 2024).

Signal vs. sampling. Granger requires adequate sampling/frequency handling; DBNs help with shorter series; prefer convergent evidence across methods (Seth et al., 2015; Barnett et al., 2018).

6.1.4 How this section connects to the energetic prior

Because the nine pathways update θ_t and C_t, they modulate both risk/ambiguity structure and energetic terms in $G_{t(\pi)}$. For example, training (**C→N**) reduces per-action cost $C(A_t)$, while sleep/nutrition perturbations (**N**) shift energetic sensitivity α via **LC–NE/arousal–effort mechanisms** (Aston-Jones & Cohen, 2005). These changes move regime boundaries (where G curves cross) and alter pupil–cost slopes, providing identifiable behavioral and physiological signatures (Dehaene & Changeux, 2011; Seth et al., 2015).

6.2 Mathematical Formalization: From Metaphor to Model

Formal models let us specify priors, derive predictions, and register falsifiers. We highlight **three complementary formalisms** *that map NiCE claims to data-generating processes*.

6.2.1 State-Space Models for Skill Acquisition

Skill acquisition is *a trajectory through a constrained state space defined by performance dimensions* (e.g., speed, accuracy, automaticity). Natural constraints (N) and environmental scaffolds (E) shape the landscape; conscious action (C) selects paths:

$S_{\{t+1\}} = f(S_t, A_t, N, E_t)$. This aligns with classic accounts of practice and automatization (Newell & Rosenbloom, 1981).

The dynamic progression of skill is formally modeled by the following equation:

$$S_{\{t+1\}} = f(S_t, A_t, N, E_t)$$

Where:

- S_t is the skill state at time t
- A_t is the action taken at time t (influenced by consciousness)
- N represents the natural constraints on learning
- E_t represents the environmental scaffolding at time t

This formalization allows us to make specific predictions about learning trajectories under different conditions and to test how manipulations of environmental scaffolding interact with natural constraints.

6.2.2 Hierarchical Bayesian Models for Cultural Learning

Cultural learning can be modeled using hierarchical Bayesian frameworks, where cultural knowledge provides the prior distributions that shape individual learning (Tenenbaum, Kemp, Griffiths, & Goodman, 2011). This captures how the environment (E) configures the expression of natural capacities (N) through conscious learning processes (C).

$$P(h|d,c) \propto P(d|h) \times P(h|c).$$

Environmental structure configures the expression of natural capacities through conscious learning, explaining systematic cross-cultural differences in perception and decision (Tenenbaum et al., 2011; Kitayama & Park, 2010).

Hierarchical Bayes captures *how cultural priors shape inference,*

Formally:

$$P(h|d,c) \propto P(d|h) \times P(h|c)$$

Where:

- h represents a hypothesis or belief
- d represents observed data
- c represents cultural knowledge
- $P(h|c)$ is the culturally shaped prior probability of hypothesis h
- $P(d|h)$ is the likelihood of observing data d given hypothesis h

This formalization allows us to test how cultural differences in prior beliefs influence learning, perception, and decision-making, and how these cultural priors interact with universal cognitive mechanisms.

6.2.3 Active Inference for Intentional Action

Active inference describes *policy selection* that minimizes **expected free energy (EFE)**, combining **instrumental (extrinsic)** and **epistemic drives** (Friston et al., 2017). We *extend the canonical objective with an explicit energetic prior so that biological constraints* (**N**) *directly bias policy choice*:

$$G(\pi) = E_{Q(o|\pi)}[-\ln P(o)] + E_{Q(s|\pi)}\big[H\big(P(o|s)\big)\big] + \alpha \cdot E_{Q(s|\pi)}[C(\pi, s)],$$

where α scales metabolic cost $C(\pi, s)$. This yields testable predictions: as α increases (e.g., via sleep restriction), energy-conserving policies become more likely; as α decreases (e.g., glucose/caffeine), exploration and goal-directed choices recover (Raichle & Gusnard, 2002).

Intentional action—where consciousness (**C**) modifies the environment (**E**) under natural constraints (**N**)—can be described using **active inference** (Friston, FitzGerald, Rigoli, Schwartenbeck, & Pezzulo, 2017). In this framework, *agents minimize* **expected free energy (EFE)** *by selecting policies that balance* **goal pursuit**, **uncertainty reduction**, *and* **metabolic efficiency**:

To illustrate the practical implications of energetic priors in active inference, we present a toy simulation that *demonstrates how the parameter α systematically reorders policy preferences based on energetic constraints*. This simulation provides concrete evidence for the theoretical claims of our triadic framework and establishes clear empirical targets for experimental validation.

The energetic prior over policies is formalized as $P(\pi) \propto \exp\{-\alpha\, E_{Q(s|\pi)}[C(\pi, s)]\}$, where α represents the energetic sensitivity parameter, and $C(\pi, s)$ denotes the metabolic cost of policy π in state s. This prior systematically biases policy selection toward energy-conserving strategies as α increases, creating identifiable behavioral signatures that can be recovered from choice data.

$$\pi^* = \arg min_\pi G(\pi)$$

Where:

- π: **a policy** (sequence of actions),
- $\boldsymbol{G(\pi)}$: **expected free energy of policy $\boldsymbol{\pi}$**,
- $\boldsymbol{\pi^*}$: **the optimal policy**.

Decomposition of Expected Free Energy

$$G(\pi) = \underbrace{E_{Q(o|\pi)}[-\ln P(o)]}_{Extrinsic\ Value\ (Risk)} + \underbrace{E_{Q(s|\pi)}\big[H[P(o|s)]\big]}_{Epistemic\ Value\ (Ambiguity)} + \underbrace{\alpha \cdot E_{Q(s|\pi)}[C(\pi, s)]}_{Metabolic\ Cost}$$

Table 29 - Decomposition of Expected Free Energy - Variable Glossary

---

- **Extrinsic Value (Risk):**
  $E_{Q(o|\pi)}[-\backslash ln\ P(o)]$. Captures alignment between predicted and preferred outcomes. Minimization drives **goal-directed behavior**.

- **Epistemic Value (Ambiguity):** $E_{Q(s|\pi)}\big[H[P(o|s)]\big]$. Expected outcome uncertainty given hidden states. Minimization drives **information-seeking behavior**.

- **Metabolic Cost:** $\alpha \cdot E_{Q(s|\pi)}[C(\pi, s)]$.

  - $C(\pi, s)$: cumulative cost of executing policy π from state s, aggregated across time steps.

  - α: trait-like sensitivity to energy expenditure.
    Interpreted as a prior belief favoring low-cost policies:

$P(\pi) \propto exp(-C(\pi))$,

making energy-efficient policies inherently more probable.

Table 30 - Canonical vs. Extended Framework

This table highlights that the only departure from canonical active inference is the explicit inclusion of an energetic prior—integrating biological constraint (N) directly into the policy calculus.

6.3 Parameter Estimation and Identifiability

Preregistration: Energetic Prior in Active Inference

Design. A within-subject 2×2 manipulation of Sleep (normal vs. restricted) × Nutrition (glucose/caffeine vs. placebo) orthogonalizes cost and reward signals. Behavior (choices/reaction times) and physiology (continuous pupillometry) are recorded to jointly identify α (cost sensitivity) and γ (policy precision). Orthogonality avoids confounding α with γ; multimodal estimation links α to both choices and pupil-cost slopes (Cools & D'Esposito, 2011).

Estimation. Fit a hierarchical model with weakly informative priors; conduct simulation-based calibration and parameter-recovery to confirm identifiability. Compare the full model to an ablated model with α=0 using LOO/WAIC; posterior-predictive checks should show the ablated model fails to capture energy-conserving choices and pupil-cost coupling.

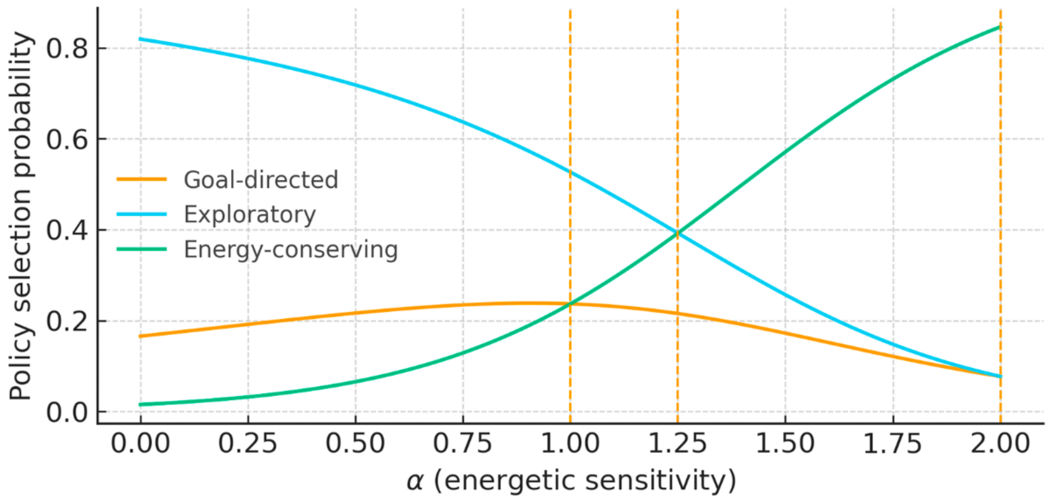


Figure 11 - Policy-selection probabilities vs. energetic sensitivity (α).

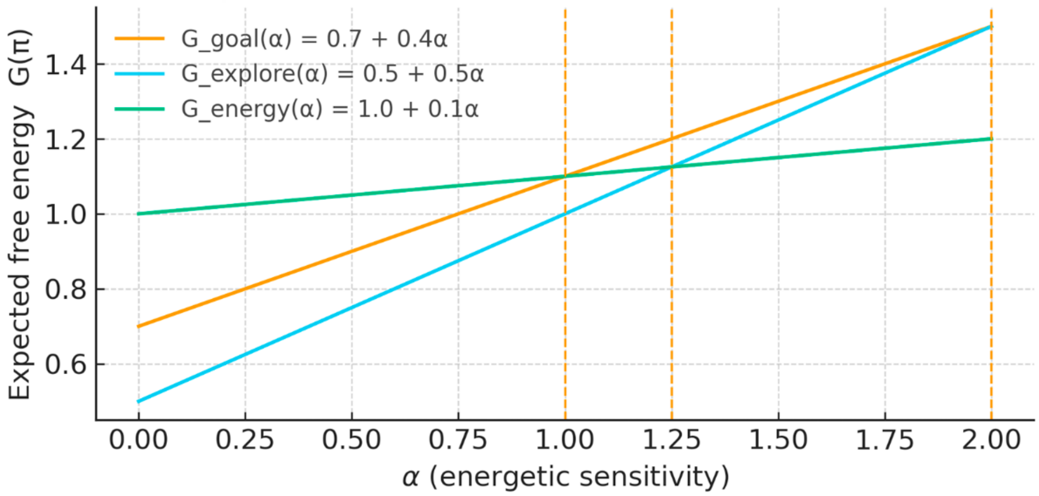


Figure 12 - Expected free energy (G) vs. energetic sensitivity (α) for goal-directed, exploratory, and energy-conserving policies.

Table 31 - Expected Free Energy decomposition: extrinsic value (risk), epistemic value (ambiguity), and metabolic cost (energetic prior).

Symbol	Meaning	Role in the Equation
$G(\pi)$	Expected Free Energy of policy π.	The total score (objective function) that policies are evaluated against.
π	A policy (sequence of actions).	The "candidate plan" the agent might follow.
o	Observable **outcomes**.	Concrete sensory inputs or observations the agent receives.
s	Hidden **states** of the world.	Latent/underlying causes that generate outcomes but are not directly observable.
$Q(o \mid \pi)$	Predicted distribution over outcomes given policy π.	Encodes "what I expect to see if I follow this plan."
$P(o)$	Preferred outcome distribution.	Encodes goals or prior preferences (what the agent *wants* to observe).
$-\ln P(o)$	**Surprise** (negative log probability of outcome o).	Converts probabilities into costs: unlikely outcomes = high cost, likely outcomes = low cost.
$E_{Q(o \mid \pi)}[\cdot]$	Expectation with respect to predicted outcomes under policy π.	Used to compute the average surprise across all possible outcomes.
$Q(s \mid \pi)$	Predicted distribution over hidden states given policy π.	Encodes "what situations I expect to encounter if I follow this plan."
$P(o \mid s)$	Likelihood distribution of outcomes given hidden state s.	The generative model mapping from hidden states to observable outcomes.
$H[P(o \mid s)]$	Entropy (uncertainty) of the likelihood distribution.	Quantifies ambiguity in outcomes if the world is in state s.

Symbol	**Meaning**	**Role in the Equation**
$E_{Q(s\mid\pi)}[\cdot]$	Expectation with respect to predicted hidden states under policy π.	Used to compute the average ambiguity and cost across possible states.
$C(\pi, s)$	Cumulative metabolic cost of executing policy π starting from state s.	Encodes energy expenditure associated with carrying out the policy.
α	Cost-sensitivity parameter.	Scales how strongly metabolic costs constrain policy selection.

Table 32 - Canonical vs. extended active-inference objective, with empirical proxies (behavioral choice, pupillometry, metabolic imaging).

Canonical Active Inference	**Extended Framework (C–N–E)**	**Empirical Proxies**
Extrinsic Value: alignment with preferences (risk minimization)	Same term retained, labeled as pragmatic goal alignment	Choice consistency, avoidance behavior
Epistemic Value: uncertainty resolution, novelty seeking	Labeled as "ambiguity reduction," tied to exploratory drive	Pupil dilation, **LC-NE** activity
(No explicit energetic term)	**Metabolic Cost**: cumulative cost of policy $C(\pi, s)$, weighted by α	Pupillometry, **CMRglc**, effort-related arousal
Priors over outcomes only	Priors over outcomes **and costs**: $P(\pi) \propto e^{\{-C(\pi)\}}$	Links physiology with policy selection

6.3.1 Data Structure and Parameters

Parameter recovery: *sample parameters → simulate → refit*; *report* r^2, *coverage*, and *calibration*.

Model comparison: **full** vs. $\alpha - free$.

Sensitivity: *alternative cost bases* and *pupil models*.

Predicted directional effects: $\boldsymbol{\alpha}$ increases with sleep restriction and decreases with glucose/caffeine; pupil-cost slope κ_1 mirrors α (Fleming & Lau, 2014).

Per participant i: choices at, rewards/observations, trial-wise effort proxies (time/force/distance), and pupil op, t.

Parameter set: $\Theta i \ = \{\alpha i, \gamma i, \beta i, \kappa i, \sigma p, i\}$ where:

• α: cost-sensitivity (energetic prior)

• γ: policy precision (softmax temperature)

• β: cost mapping coefficients

• κ: physiology links

• σp: pupil noise

6.3.2 Mathematical Framework

Expected Free Energy with energetic prior:

$$G(\pi) = \ EQ(o|\pi)[-\ln P(o)] + \ EQ(s|\pi)\big[H\big(P(o|s)\big)\big] + \ \alpha \ \cdot \ EQ(s|\pi)[C(\pi,s)]$$

Policy prior: $P(\pi) \propto \exp\{-\alpha \ \cdot \ EQ(s|\pi)[C(\pi,s)]\}$

Choice model: $P(\pi|\Theta) \ \propto \exp\{-\gamma \ \cdot \ G(\pi)\}$

Cost mapping (observable):

$$C(At, st) = \ \beta 0 \ + \ \beta 1 \cdot workt \ + \ \beta 2 \cdot timet \ + \ \beta 3 \cdot distancet$$

Policy cost: $C(\pi,s) = \ \Sigma t \ C(At, st)$

Physiology model:

$$op, t \sim Normal(\kappa 0 \ + \ \kappa 1 \cdot C(At, st) + \ \kappa 2 \cdot Riskt \ + \ \kappa 3 \cdot Ambiguityt, \sigma p^2)$$

Joint likelihood: $L(\Theta) = \ \Pi t \ P(at|\Theta) \cdot \ P(op, t|\Theta)$

6.3.3 Identifiability Strategy

Orthogonal Design:

Ensure reward and cost vary independently to prevent α being absorbed by γ.

Multi-Modal Estimation:

• α affects $G(\pi)$ through cost term AND predicts pupil via $\kappa 1$

• γ controls choice stochasticity without affecting pupil-cost relationship

• Joint behavior+physiology estimation disambiguates α vs. γ

Scale Calibration:

Resolve α–cost scale ambiguity via:

• Pre-task calibration (force→Joules, time→seconds)

• Set $\beta 1 \;=\; 1 \; or \; z - score \; C(At, st)$ within participant

Causal Anchors:

Experimental manipulations with directional predictions:

• Sleep restriction → increased α

• Glucose/caffeine → decreased α

• Pupil-cost slopes κ1 should mirror α changes

6.3.4 Validation Protocol

Parameter Recovery:

• Sample Θ from priors → simulate choices+pupil → fit model

• Report recovery r^2, calibration slopes, CI coverage for all parameters

• Test robustness across task structures (bandit vs. gridworld)

Model Comparison:

• Full model vs. no energetic prior (α = 0)

• Use LOO/WAIC and posterior predictive checks

• No-α model should fail to capture energy-conserving choices and pupil-cost slopes

Priors and Sensitivity:

• Weakly informative priors: α ~ HalfNormal(0,1), γ ~ HalfNormal(0,5)

• Scale costs so $\alpha \;=\; O(1)$

• Alternative pupil models and cost bases for robustness

6.3.5 Deliverables

Recovery plots, posterior predictive checks, model comparison table, within-subject contrasts $\Delta\alpha$ with 95% CIs.

Design: 2×2 within-subject, counterbalanced across four sessions: Sleep (Normal vs. Restricted ~5h) × Nutrition (Glucose/Caffeine vs. Placebo). Washout ≥48h. Morning sessions; caffeine abstinence ≥12h. $n \approx 36$.

Task: Cost-sensitive bandit (optional gridworld replication). Each sample/action has calibrated effort cost $C(A_t)$ (time/force). Arms dissociate extrinsic value (reward) and epistemic value (information under volatility).

Primary Outcomes (Confirmatory):

1. Posterior cost-sensitivity α increases under Sleep-Restricted vs. Normal; decreases under Glucose/Caffeine vs. Placebo.
2. Policy choice: higher selection of energy-conserving options with sleep restriction; reduction with glucose/caffeine.

Secondary Outcomes (Exploratory):

• Pupil–cost slope $(\kappa 1)$ increases with sleep restriction and decreases with glucose/caffeine.

• Exploration rate (epistemic choices) decreases with sleep restriction; increases with glucose/caffeine when values are balanced.

• Reaction times shift consistently with increased effort aversion.

Hypotheses (Directional):

H1: $\alpha Restricted > \alpha Normal.$

H2: $\alpha Glucose/Caffeine < \alpha Placebo.$

H3: $\kappa 1$ mirrors α across conditions.

H4: Policy selection changes are mediated by $\Delta\alpha$.

Measures & Recording:

Behavior (choices, RT); continuous pupillometry (tonic + phasic; blink-handled); actigraphy/sleep diary compliance; SSS (sleepiness).

Model & Estimation:

Policy prior: $P(\pi) \propto \exp\, -\alpha \cdot E_{Q(S|\pi)}[C(\pi, s)]$.

EFE: $G(\pi) = EQ(o|\pi)[-\ln P(o)] + EQ(s|\pi)[H(P(o|s))] + \alpha \cdot E_{Q(S|\pi)}[C(\pi, s)]$.

Choice: $P(\pi|\Theta) \propto exp - \gamma \cdot G(\pi)$ softmax precision γ).

Physiology:

$op, t \sim Normal(\kappa 0 + \kappa 1 \cdot C(A_t, s_t) + \kappa 2 \cdot Risk_t + \kappa 3 \cdot Ambiguity_t, \sigma p^2).$

Hierarchical Bayes: $participant\ \alpha i \sim Normal(\mu\alpha, \sigma_{\alpha}^{2})$; within-subject contrasts for Sleep/Nutrition.

Sample Size & Power:

Target $n = 36$ (within-subject; $d \approx 0.6$ for α contrasts; $.80\ power, \alpha = .05$). Final N justified via simulation-based power using the fitted generative model.

Analysis Plan (Confirmatory):

Posterior contrasts on α between Sleep and Nutrition conditions; LOO/WAIC vs. $\alpha = 0$ ablation; posterior predictive checks for choices and pupil. FDR for confirmatory contrasts; others exploratory.

Exclusions & Compliance:

Pre-registered artefact thresholds $(blink/missing\ pupil\ > 20\%)$, sleep/caffeine non-compliance, extreme RTs handled via robust modeling (no listwise deletion).

Ethics:

Minimal sleep restriction; withdrawal permitted; glucose/caffeine doses within standard lab protocols; adverse-event monitoring.

OSF/As-Predicted Fields to Fill:

Team, timeline, IRB status, exact dosing, randomization seeds, counterbalancing scheme, raw/derived data release plan.

6.3.4 Energetic Constraints in Skill Acquisition

Skill acquisition can be expressed as a **time-step approximation** of repeated policy selection under EFE minimization (Laughlin, de Ruyter van Steveninck, & Anderson, 1998). Here, metabolic costs enter directly into the dynamics of competence growth:

$$S_{t+1} = f(S_t, A_t, N, E_t) - \alpha \cdot C(A_t).$$

Where:

- S_{t+1}: skill state at time $t + 1$,
- $f(S_t, A_t, N, E_t)$: baseline skill dynamics given current state, action, constraints, and environment,
- $C(A_t)$: immediate cost of action A_t,
- α: same cost-sensitivity parameter as above.

Interpretation:

- This equation follows naturally from minimizing EFE with a cost-sensitive prior.
- The subtraction term $-\alpha \cdot C(A_t)$ reflects the **drag of energetic expenditure** on learning.
- It represents the **per-step analogue** of the cumulative policy-level costs in the EFE decomposition.

Implications:

- **Learning trajectories:** costly actions slow or flatten acquisition curves.
- **Decision-making:** lower-cost strategies may be selected even if suboptimal in performance.
- **Skill development:** scaffolding that reduces action cost (tools, optimized practice structures) accelerates mastery.

By linking per-step skill dynamics to policy-level EFE minimization, this framework ties together action selection, energy constraints, and learning in a unified probabilistic calculus.

6.3.5 Illustrative Simulation: Cost-Sensitive Policy Selection

The simulation establishes clear methodological targets for empirical validation. The predicted α values for policy regime transitions ($\alpha \approx 1.0$) can be tested through experimental manipulations of energetic constraints, such as sleep restriction or metabolic challenges. Physiological measures (e.g., pupillometry) can provide convergent validation of the energetic cost parameter, creating a multi-modal approach to testing the triadic framework's core predictions.

6.4 Measurement Strategy: Operationalizing the Triad

Operationalization spans molecules to culture, and first-person to physiology, to capture how N, C, and E co-determine outcomes.

The toy simulation implements a simplified three-policy scenario where agents choose between goal-directed, exploratory, and energy-conserving strategies under varying energetic constraints. Each policy is characterized by distinct expected free energy profiles:

$$G_{goal(\alpha)} = 0.7 + 0.4\alpha, G_{explore(\alpha)} = 0.5 + 0.5\alpha, and\ G_{energy(\alpha)} = 1.0 + 0.1\alpha,$$

where α represents the energetic sensitivity parameter.

Policy selection follows a softmax function $P(\pi|\Theta) \propto \exp[-\gamma G(\pi)]$, where γ controls the precision of choice. As α increases from 0 to 2, the simulation reveals systematic regime shifts in policy preferences, with crossover points occurring when different policies achieve equivalent expected free energy values.

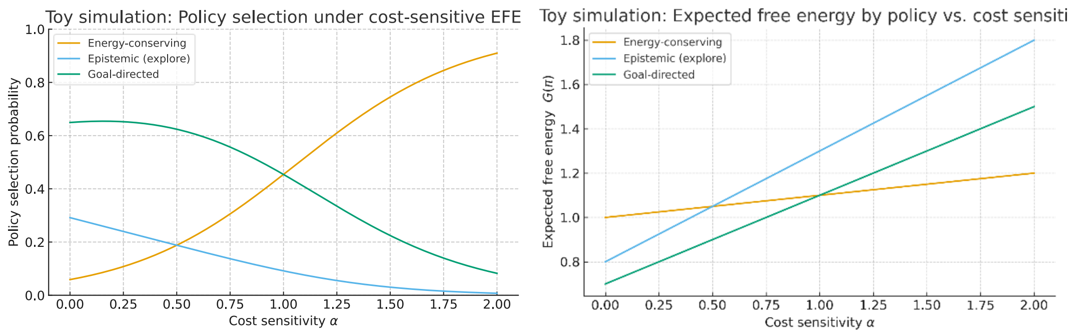


Figure 13 - Toy Simulation of Cost Sensitive Expected Free Energy

Presents the simulation results across two complementary panels. Panel (a) shows policy selection probabilities as functions of α, revealing S-shaped transition curves as energetic constraints strengthen. Panel (b) displays the underlying expected free energy landscapes, with crossing points that mechanistically explain the regime shifts observed in panel (a).

(a) Policy selection probabilities vs. energetic sensitivity α: rising α shifts behavior from goal-directed to energy-conserving policies. (b) Underlying expected free energy $G(\pi)$ by policy showing crossover points that explain regime shifts in (a). This demonstrates how energetic priors systematically alter the policy landscape, yielding identifiable and experimentally testable predictions.

The simulation demonstrates several key theoretical predictions. First, the energetic parameter α systematically reorders policy preferences, with goal-directed policies dominating at low α and energy-conserving policies emerging at high α. Second, the crossover points provide clear identifiability signatures that can be recovered from behavioral data. Third, the regime transitions occur at predictable α values ($\alpha \approx 1.0$ for the goal-energy crossover), establishing concrete targets for experimental manipulation.

These results validate the mathematical tractability of energetic priors within active inference and provide a concrete foundation for the empirical predictions outlined in Section 5. The simulation bridges abstract theoretical claims with measurable behavioral outcomes, demonstrating how Nature-Consciousness-Environment interactions can be formalized and tested empirically.

To empirically test our framework, we need specific measurement strategies for each corner of the triad and for the interactions between them. Here we outline a comprehensive approach to measurement that combines multiple methods and levels of analysis.

6.4.1 Measuring Nature (N): Evolved Capacities and Constraints

Genetic/epigenetic markers (GWAS, methylation); neuromodulatory profiles (PET, pharmacological challenges); energetic measures (CMRglc/fMRI/fNIRS); plasticity assessments (longitudinal training, TMS). These quantify constraint priors and plasticity envelopes shaping conscious processes (Plomin, DeFries, Knopik, & Neiderhiser, 2016; Raichle & Gusnard, 2002; Wenger et al., 2017).

Genotypic/Epigenetic Markers: Genetic polymorphisms and epigenetic modifications related to cognitive and behavioral traits can be assessed through DNA methylation analysis, genome-wide association studies (GWAS), and candidate gene approaches (Plomin, DeFries, Knopik, & Neiderhiser, 2016).

Neuromodulatory Profiles: Individual differences in neuromodulatory systems (e.g., dopamine, serotonin, norepinephrine) can be assessed through PET imaging, pharmacological challenges, and indirect behavioral measures (Cools, & D'Esposito, 2011).

Energetic Measures: Metabolic constraints can be measured through cerebral metabolic rate of glucose consumption (CMRglc), functional near-infrared spectroscopy (fNIRS), and functional magnetic resonance imaging (fMRI) (Raichle, & Gusnard, 2002).

Plasticity Assessments: The bounds of neural and behavioral plasticity can be assessed through longitudinal training studies, transcranial magnetic stimulation (TMS) measures of cortical excitability, and learning rate analyses (Wenger, Brozzoli, Lindenberger, & Lövdén, 2017).

6.4.2 Measuring Consciousness (C): Lived Experience

Phenomenal consciousness: perturbational complexity index and neural complexity measures; Access consciousness: reportability and global-broadcast signatures (P3b/"ignition"); Metacognition: meta-d′/d′, confidence calibration; Intentionality: goal maintenance under distraction, policy-selection latency, and meaning-in-life scales (Casali et al., 2013; Dehaene & Changeux, 2011; Fleming & Lau, 2014; Steger, Frazier, Oishi, & Kaler, 2006).

Methodological pluralism. Combine micro-phenomenological interviews, contemplative-neuroscience protocols, embodied interaction paradigms, and reciprocal neurophenomenology to integrate first-person and neural data (Petitmengin, Remillieux, & Valenzuela-Moguillansky, 2019; Berkovich-Ohana et al., 2020).

Phenomenal Consciousness (P): While direct measurement remains challenging, proxy measures include perturbational complexity index (PCI), neural complexity measures, and first-person phenomenological reports (Casali, Gosseries, Rosanova, Boly, Sarasso, Casali, & Massimini, 2013).

Access Consciousness (A): Reportability, global broadcasting dynamics, and P3b/ignition signatures can be assessed through behavioral measures (e.g., report accuracy, reaction time), EEG markers, and fMRI patterns of global activation (Dehaene, Changeux, 2011).

Reflective Self-Awareness: Metacognitive efficiency (meta-d'/d'), confidence calibration, and introspective accuracy can be measured through confidence judgments, error monitoring, and metacognitive discrimination tasks (Fleming, & Lau, 2014).

Intentionality: Goal maintenance under distraction, policy selection latency, and meaning-in-life scales can be used to assess the directed and interpretive dimensions of consciousness (Steger, Frazier, Oishi, & Kaler, 2006).

Phenomenological Validation and First-Person Methodologies

Measuring consciousness within the triadic framework requires methodological pluralism that bridges **first-person experiential reports**, **third-person neural measurements**, and **second-person intersubjective validation**. Traditional approaches often treat subjective reports as merely correlational with 'real' neural measures. However, our framework *positions phenomenological data as constitutive rather than merely epiphenomenal*—experiential reports provide access to organizational regimes that cannot be captured through neural measurements alone.

We propose a multi-dimensional measurement strategy that integrates:

1. **Micro-phenomenological interviews** that capture fine-grained temporal dynamics of experience

   These interviews provide structured access to the fine-grained temporal unfolding of lived experience. By guiding participants to describe micro-dynamics of perception, attention, and affect, researchers can uncover patterns invisible to coarse behavioral or neural measures. This method enhances the reliability of first-person data and allows intersubjective validation of experiential structures (Petitmengin, Remillieux, & Valenzuela-Moguillansky, 2019).

2. **Contemplative neuroscience protocols** that combine meditation-based introspection with real-time neural feedback

   Meditation and contemplative practices cultivate refined introspective access, making practitioners skilled observers of their own mental states. When combined with real-time neural feedback, these protocols allow researchers to correlate subjective reports with dynamic neural signatures, advancing understanding of how training shapes consciousness (Josipovic & Baars, 2015).

3. **Embodied interaction paradigms** that assess how environmental perturbations affect conscious content

   Consciousness is not only neural but also embodied and environmentally embedded. Experimental paradigms that perturb bodily states (e.g., posture, interoception) or environmental affordances (e.g., sensory context, social presence) reveal how conscious content is co-constituted by organism–environment coupling. This approach operationalizes the NiCE emphasis on relational dynamics (Signorelli & Boils, 2024).

4. **Neurophenomenological validation** where first-person descriptions guide neural analysis and vice versa.

   Neurophenomenology explicitly integrates first-person experiential reports with third-person neural data, creating reciprocal constraints between them. This approach avoids treating subjective reports as epiphenomenal and instead uses them to guide neural analysis (e.g., identifying relevant time windows or network dynamics). It operationalizes Varela's vision of a science of consciousness that honors both phenomenology and neuroscience (Berkovich-Ohana et al., 2020).

This approach treats consciousness not as a thing to be measured but as *a dynamic process to be characterized through its relational patterns*.

Connecting IIT Metrics to Subjective Experience

Integrated Information Theory provides quantitative measures (φ, Φ) that can be mapped onto specific aspects of conscious experience within our triadic framework. However, rather than treating φ as merely correlating with consciousness, we propose that *integrated information measures capture specific dimensions of triadic organization*. High φ values correspond to states where internal models, environmental constraints, and bodily dynamics achieve maximal mutual specification—generating rich, unified conscious experience.

The quality structure predicted by IIT (qualia space) can be empirically validated through systematic phenomenological mapping. Participants trained in contemplative introspection can provide detailed reports of experiential quality changes that correspond to predicted φ-structure modifications. For instance, *changes in visual attention that alter information integration patterns should produce specific, reportable changes in the character of visual experience*. Such studies move beyond simple detection paradigms toward characterizing the qualitative structure of conscious experience as predicted by formal measures.

Dynamic Consciousness Assessment

Static measures of consciousness fail to capture its fundamentally temporal and relational nature. Our framework emphasizes dynamic assessment protocols that track how conscious experience unfolds through environmental interaction. This includes:

1. Real-time tracking of attention allocation during complex environmental navigation

   Consciousness is tightly coupled to attentional dynamics, especially in ecologically valid tasks like navigation. Real time tracking (e.g., eye tracking, mobile EEG, VR paradigms) reveals how attention is flexibly allocated across environmental affordances, showing how conscious content is shaped by ongoing interaction with the world (Heft, 2013).

2. Moment-to-moment assessment of awareness during skill acquisition

   Consciousness is not static but evolves as skills are learned. Moment to moment measures (e.g., confidence ratings, error monitoring, mindfulness probes) capture how awareness fluctuates between explicit monitoring and implicit flow states. This approach links conscious awareness to learning curves and performance adaptation (Herbert & Afari, 2023).

3. Longitudinal studies of how consciousness-environment coupling changes through development

   Consciousness unfolds across the lifespan, shaped by both genetic and environmental factors. Longitudinal designs reveal how stability and plasticity *in conscious–environment* coupling evolve, showing how temporal integration capacities and metacognitive awareness mature (Tucker Drob & Briley, 2014).

4. Intervention studies examining how environmental modifications affect conscious content and organization.

   Consciousness is relational and can be reshaped by environmental interventions (e.g., sensory enrichment, contemplative training, digital environments). Intervention studies test causal hypotheses about how modifying context alters conscious content, validating the NiCE emphasis on constitutive dynamics (Mackenzie, Fegley, Stutesman, & Mills, 2020).

These dynamic approaches reveal consciousness as *an achievement of active engagement rather than a passive state.* Measures focus on the flexible responsiveness of conscious systems—their ability to maintain coherent experience while adapting to environmental changes. This includes assessing metacognitive awareness (consciousness of consciousness), temporal integration across multiple timescales, and the capacity for conscious control over attention and action. Such measures capture consciousness as a regulatory process rather than merely a representational state.

6.4.3 Measuring Environment (E): Constitutive Context

Socioecological indicators include **cultural tightness–looseness**, **relational mobility**, **artifact density**, and *representational toolkits that scaffold cognition and collective intelligence* (Gelfand, Nishii, & Raver, 2006; Thomson et al., 2018; Henrich, 2003; Donald, 1991).

Cultural Tightness–Looseness. The *strength of social norms and tolerance for deviance* can be systematically assessed using validated scales and behavioral observations (Kitayama & Park, 2010). **Tight cultures** *enforce strong norms and sanction deviance*, while **loose cultures** *allow greater behavioral latitude*. Measuring this dimension helps capture *how normative environments shape conscious experience and social regulation* (Gelfand, Nishii, & Raver, 2006).

Relational Mobility. Relational mobility refers to the degree of freedom individuals have to form and leave social relationships. High relational mobility contexts foster proactive social behaviors (e.g., self-disclosure, trust), while low mobility contexts constrain choice and emphasize stability. Self-report scales and social network analyses provide robust measures of this socioecological variable (Thomson, Yuki, Talhelm, Schug, Kito, Ayanian, & Visserman, 2018).

Artifact Density. The prevalence and diversity of material culture—tools, symbols, and technologies—reflect the extent to which environments scaffold cognition and social coordination. Quantifying artifact density through surveys and historical analyses highlights how cultural evolution shapes the external supports of consciousness and cooperation (Henrich, 2004).

Representational Toolkits. External symbolic storage systems (e.g., writing, diagrams, digital media) extend cognitive capacity beyond the brain. Assessing the availability and sophistication of these representational toolkits through cultural inventories and historical analyses reveals how environments co-constitute memory, reasoning, and collective intelligence (Donald, 1991).

6.4.4 Measuring Interactions: Integrated Assessment

Nature–Consciousness: twin designs, pharmacogenomics, and $gene \times environment$ analyses;

Environment–Consciousness: cross-cultural comparisons and contextual manipulations;

Nature–Environment: niche construction via cultural-evolution experiments and historical modeling; Triadic: longitudinal, cross-cultural, and computational studies integrating all three (Creanza et al., 2017; Kitayama & Park, 2010).

Nature-Consciousness Interactions: The influence of genetic factors on conscious experience can be assessed through twin studies, pharmacogenomics, and gene-environment interaction analyses (Turkheimer, 2000).

Environment-Consciousness Interactions: The impact of cultural factors on conscious experience can be measured through cross-cultural comparisons, acculturation studies, and experimental manipulations of environmental context (Kitayama, & Uskul, 2011).

Nature-Environment Interactions: Niche construction processes can be studied through cultural evolution experiments, gene-culture coevolution models, and historical analyses of technological and social change (Creanza, Kolodny, & Feldman, 2017).

Triadic Interactions: The complex interplay of all three factors can be investigated through longitudinal developmental studies, cross-cultural developmental comparisons, and computational models that incorporate all three dimensions (Muthukrishna, & Henrich, 2016).

This **comprehensive measurement strategy** provides *a roadmap for empirical investigations of our triadic framework, allowing for rigorous testing of its key claims and predictions.*

[Insert Figure 3. Cost-sensitive EFE simulation here]

Toy simulation: policy-selection probabilities and EFE curves as a function of α (energetic sensitivity).

7. Empirical Predictions and Research Program

We treat the energetic prior (α) as manipulable and person-specific. All trials report (i) a primary endpoint per vertex (N/C/E), (ii) a pre-registered interaction that would support the **strong triadic** claim, and (iii) falsifiers when multi-lever ≤ additive. We fix covariates (sleep, nutrition, baseline HRV, SES, cultural tightness), exclusion criteria (noncompliance, medication changes), and minimal detectable effects from power analyses. α is indexed by composite cost markers (sleep debt, HRV, perceived effort) and perturbed via sleep/caffeine/nutrition micro-interventions, with blinding where feasible.

A robust theoretical framework *must generate testable predictions that can guide empirical research*. Building on the simulation results presented in Section 4.2.5, this section outlines specific empirical predictions and experimental approaches for validating energetic priors in human decision-making. The simulation's demonstration of systematic policy regime shifts at predictable α values provides concrete targets for experimental manipulation and falsifiable hypotheses for empirical testing.

For each prediction, we provide a detailed rationale, specific experimental designs, expected outcomes, and methodological considerations. We specify a primary endpoint and an interaction pattern whose absence would count against the strong triadic claim. We pre-register covariates and exclusion criteria to prevent model overfit and to ensure falsifiability.

7.1 Intervention Symmetry: Multi-lever Approaches

Prediction: Changes at any vertex of the triad (nature, consciousness, environment) can propagate to the others; interventions that target multiple vertices simultaneously will produce stronger and more sustainable effects than single-vertex interventions.

Rationale: If nature, consciousness, and environment are truly mutually constitutive, then changes in one should produce corresponding changes in the others. Furthermore, the principle of mutual constitution suggests that interventions targeting multiple vertices simultaneously should have synergistic effects, as they address the system as a whole rather than isolated components.

7.1.1 Experimental Design:

1. **2×2 Factorial Design**:
    - Factor 1: Cognitive training (metacognitive strategy) vs. control
    - Factor 2: Environmental redesign (artifact scaffolds, role norms) vs. control
    - Dependent variables: Transfer task performance, metacognitive efficiency, neural broadcasting indices
2. **Three-lever Extension**:

- ◦ Add a third factor: Symbolic tool introduction (structured journaling, external memory) vs. control
- ◦ This allows testing of the full triadic synergy hypothesis

7.1.2 Expected Outcomes:

- Main effects for each intervention type
- Significant interaction effect, with the combined intervention producing greater than additive effects
- Persistence of effects over time in the combined condition compared to single-intervention conditions

Falsification: The strong triadic claim is falsified if:

1. The synergy contrasts $\psi_2 = \hat{Y}AB - (\hat{A} + \hat{B} - \hat{Y}_0)$ and $\psi_3 = \hat{Y}ABC - (\hat{A} + \hat{B} + \hat{C} - 2 \cdot \hat{Y}_0)$ fall within $ROPE(-\Delta *, +\Delta *)$ for pre-registered $SESOI\ \Delta$*.
2. The ordered pattern fails ($\hat{Y}ABC \geq \hat{Y}AB \geq max(\hat{Y}A, \hat{Y}B, \hat{Y}C) + \delta *$).
3. Cross-vertex mediation paths (e.g., Env→Cog→Neural) are absent.
4. Effects do not persist at Δt follow-up.
5. Additive or latent-cause models outperform the triadic synergy model in pre-registered comparisons.

7.1.3 Methodological Considerations:

- Ensure that interventions are matched for intensity and duration
- Include both near and far transfer tasks to assess generalizability
- Collect measures from all three vertices to track propagation of effects

7.1.4 Triadic falsifier rule*:*

If the combined [C × E] or [E × N] intervention fails to exceed the summed main effects **and** fails to propagate to the untouched vertex within the pre-registered lag window (e.g., N→C within 2–4 weeks), count this against the strong triadic claim.

7.2 Developmental Specificity: Sensitive Periods

Prediction: The impact of environmental configuration on consciousness and nature will vary across developmental stages, with sensitive periods amplifying environmental effects; these patterns will differ by age and sociocultural niche.

Rationale: Developmental systems theory suggests that the relationship between nature, consciousness, and environment is not static but changes across the lifespan. Sensitive periods represent windows of heightened plasticity where environmental influences have particularly strong effects on developmental trajectories (Werker, & Hensch, 2015).

Experimental Design:

1 **Longitudinal Cohort Study**:

- Track multiple cohorts across key developmental transitions (e.g., literacy onset, adolescence)
- Vary cultural tightness and representational exposure across cohorts
- Measure access awareness, narrative self-coherence, epigenetic markers, and resting-state network configuration at multiple time points

2 **Cross-cultural Comparison**:

- Compare developmental trajectories across cultures with different socialization practices
- Focus on transitions that are culturally variable (e.g., age of literacy acquisition, formal education entry)

Expected Outcomes:

- Significant age-by-environment interactions on measures of consciousness and neural organization
- Different sensitive periods for different aspects of consciousness (e.g., phenomenal experience vs. reflective self-awareness)
- Cultural variation in the timing and impact of sensitive periods

Falsification: The strong claim is falsified if:

1. Pre-specified slope changes at developmental transitions (τ) fall within ROPE(–Δ*, +Δ*).
2. No cultural moderation of $age \times environment$ slopes is observed ($\Delta\Delta\beta \in ROPE$).
3. Predicted RSN reconfiguration metrics (e.g., modularity shifts) fail equivalence thresholds.
4. Additive developmental models fit better than triadic models.

Methodological Considerations:

- Control for cohort effects in longitudinal designs

- Use culturally appropriate measures and tasks
- Account for individual differences in developmental timing

7.3 Symbolic Mediation: Representational Tools

Prediction: The introduction of new representational tools (e.g., writing systems, external memory, AI copilots) will measurably reshape both neural organization and conscious task structure, with effects that extend beyond the immediate context of tool use.

Separate *performance* lift from *cognitive reorganization*: schedule retention probes after a no-tool washout; require transfer to untrained tasks; and include a metacognitive stability index (confidence calibration drift).

Rationale: Symbolic systems are not merely passive instruments but active forces that restructure cognition and consciousness. The acquisition of new representational tools should therefore produce changes in both the structure of conscious experience and the neural systems that support it (Menary, 2013).

Experimental Design:

1 **Natural Experiments**:
  - Study populations undergoing script reform or curriculum shifts
  - Compare cognitive and neural measures before and after the introduction of new symbolic systems
  - Track long-term changes in conscious experience and neural organization

2 **Randomized Controlled Trials**:
  - Introduce new representational tools (e.g., spaced-retrieval systems, AI copilots with reflective prompts)
  - Measure changes in task-structured consciousness and neural activity
  - Assess transfer to untrained tasks and contexts

Expected Outcomes:

- Changes in attentional stability, time-on-policy, and neural complexity/ignition patterns
- Reorganization of memory structures and narrative self-construction
- Transfer of effects to untrained domains that rely on similar cognitive processes

Falsification: The strong claim is falsified if:

1. Tool-specific contrasts (e.g., writing vs AI-copilot vs control) fail to produce predicted neural and behavioral signatures beyond Δ^*.

2. No transfer is observed to untrained domains (effects confined to near tasks).

3. $Tool \rightarrow representation \rightarrow behavior$ mediation is absent (indirect effect $\in$ $ROPE$).

4. Placebo tools produce effects equivalent to hypothesized tools.

5. Additive performance models outperform triadic synergy models.

Methodological Considerations:

- Ensure adequate training and familiarity with new tools
- Distinguish between immediate performance effects and genuine cognitive reorganization
- Control for motivational and expectancy effects

7.4 Plasticity Bounds: Constraint Priors

Prediction: While human capacities are highly plastic, they exhibit lawful limits set by genetically evolved constraints and energy costs; models of learning and development should include explicit constraint priors from nature.

Rationale: The principle of mutual constitution does not imply unlimited malleability. Natural constraints, particularly those related to energy metabolism and evolved neural architecture, set bounds on the possible states of the system. Understanding these constraints is essential for developing realistic models of human potential and adaptation (Bullmore, & Sporns, 2012).

Experimental Design:

1 **Incremental Training Study**:

  - Subject participants to increasingly demanding training regimens
  - Monitor metabolic activity (e.g., glucose consumption, oxygen utilization)
  - Track performance plateaus and individual differences in learning curves

2 **Manipulation of Energetic Resources**:

  - Vary sleep quality/quantity and nutritional status
  - Measure effects on cognitive performance, neural efficiency, and learning rates
  - Identify individual differences in susceptibility to resource constraints

Expected Outcomes:

- Nonlinear performance plateaus tied to energy costs
- Individual differences in learning curves predicted by "nature" constraint priors
- Trade-offs between performance dimensions (e.g., speed vs. accuracy) under resource constraints

Falsification: The strong claim is falsified if:

- Learning curves remain linear across doses (no plateau or nonlinearity).
- Energetic manipulations (sleep, nutrition) fail to shift parameters ($\Delta\alpha \in ROPE$).
- Predicted performance trade-offs (speed–accuracy frontier) do not rotate as specified.
- Constraint-free plasticity models fit data better than triadic-bounded models.

Methodological Considerations:

- Ensure ethical treatment of participants in demanding training protocols
- Control for motivational factors that might mimic genuine capacity limits
- Use multiple measures of energy consumption and neural efficiency

7.5 Cultural Priors and Metacognitive Bias

Prediction: Cultural tightness elevates the precision of prior beliefs, improving stability and performance in predictable environments but reducing exploration and metacognitive openness in novel or uncertain situations.

Rationale: Cultural systems can be understood as collections of priors that shape perception, cognition, and action. Tighter cultures, with stronger norms and lower tolerance for deviance, should promote higher precision weighting of prior beliefs, leading to more confident but potentially less flexible cognition (Gelfand, Harrington, & Jackson, 2017).

Experimental Design:

1 **Cross-cultural Comparison**:
   - Compare populations from tight vs. loose cultures on tasks measuring:
     - Exploration-exploitation balance
     - Confidence calibration
     - Policy switching in response to environmental changes
   - Model behavior using precision-weighting parameters in Bayesian frameworks

2 **Priming Study**:

  - Temporarily activate tight vs. loose cultural mindsets through priming
  - Measure effects on metacognitive bias, exploration behavior, and neural signatures of prediction error

Expected Outcomes:

- Higher precision weighting of priors in tight cultural contexts
- Better performance in stable, predictable environments for individuals from tight cultures
- Reduced exploration and slower adaptation to change in tight cultural contexts
- Differences in neural signatures of prediction error and surprise

Falsification: The strong claim is falsified if:

1. Tight vs loose cultures show no difference in prior precision η ($\Delta\eta \in ROPE$).
2. Exploration/exploitation balance does not differ across cultural conditions.
3. Neural prediction-error slopes are indistinguishable across groups and priming manipulations.
4. Additive cultural models explain variance better than triadic precision-modulation models.

Methodological Considerations:

- Control for individual differences within cultures
- Ensure cultural appropriateness of tasks and stimuli
- Consider the role of domain specificity (e.g., social vs. non-social tasks)

7.6 Rituals as Control Policies

Prediction: High-regularity rituals reduce uncertainty and free energy by stabilizing affect and attention, at the cost of flexibility; ritualized contexts will show reduced physiological variability and attentional drift but also reduced policy repertoire.

Pre-register the *flexibility cost*: a decline in policy repertoire under high-regularity routines is predicted; absence of this cost weakens the "rituals as control policies" claim.

Rationale: Rituals can be understood as culturally evolved control policies that regulate physiological states, attentional focus, and social coordination. By providing highly predictable sequences of actions and experiences, rituals should reduce uncertainty and variability in both neural and physiological systems (Lang, Krátký, Shaver, Jerotijević, & Xygalatas, 2015).

Experimental Design:

1. **Comparative Study**:
    - Compare physiological and attentional measures during:
        - Highly ritualized activities (e.g., religious ceremonies, formal rituals)
        - Semi-structured activities (e.g., casual social gatherings)
        - Improvisational activities (e.g., creative play, jazz improvisation)
    - Measure heart rate variability, skin conductance, attentional stability, and policy flexibility
2. **Intervention Study**:
    - Introduce participants to new ritualized practices
    - Track changes in physiological regulation, attentional control, and behavioral flexibility
    - Assess transfer to non-ritualized contexts

Expected Outcomes:

- Reduced physiological variability and attentional drift during ritualized activities
- More stable affective states in ritualized contexts
- Reduced policy repertoire and flexibility in ritualized contexts
- Transfer of regulatory benefits to non-ritualized contexts after ritual training

Falsification: The strong claim is falsified if:

- Ritualized contexts do not reduce physiological variance (e.g., HRV, EDA) or attentional drift relative to semi-structured/improvisational contexts.
- Policy-repertoire entropy does not decrease during rituals.
- No spillover regulatory benefits are observed in non-ritual contexts.
- Placebo synchrony conditions produce effects equivalent to rituals.
- Additive arousal-regulation models outperform triadic ritual-as-policy models.

Methodological Considerations:

- Control for familiarity and expertise with ritualized practices
- Consider individual differences in ritual engagement and meaning-making
- Distinguish between effects of physical synchrony and symbolic content

7.7 Measurement Glossary

To facilitate empirical testing of these predictions, we provide a glossary of key constructs and their corresponding measurement approaches:

Table 33 - Measurement Glossary

Constructs	Definition	Measurement Approaches
Nature Constructs		
Constraint Priors	Evolved capacities that set boundaries on development	Genetic polymorphisms, twin studies, cross-species comparisons
Energy Budgets	Metabolic resources available for cognitive processes	CMRglc, fNIRS, pupillometry, glucose monitoring
Plasticity Envelope	Range of possible phenotypic expressions	Learning rate analyses, training response curves, TMS measures
Consciousness Constructs		
Phenomenal Experience	Subjective, qualitative aspects of consciousness	PCI, neural complexity measures, phenomenological reports
Access Awareness	Global availability of information for cognitive processing	Report accuracy, P3b signatures, global ignition patterns
Reflective Self-Awareness	Metacognitive monitoring of one's own mental states	Meta-d'/d', confidence calibration, error awareness
Intentionality	Goal-directed control of attention and action	Goal maintenance tasks, meaning-in-life scales, policy selection measures
Environment Constructs		
Ecological Affordances	Action possibilities provided by the physical environment	Environmental surveys, affordance inventories, action boundary measures

Constructs	Definition	Measurement Approaches
Symbolic Tools	Representational systems that mediate cognition	Cultural inventories, symbolic complexity measures, external memory assessments
Institutional Structures	Social organizations, norms, and roles	Cultural tightness scales, institutional analysis, social network measures
Developmental Inputs	Formative influences during development	Parenting measures, educational quality assessments, nutrition and health indicators

This measurement glossary provides a starting point for operationalizing the key constructs in our framework and designing empirical studies to test its predictions. By specifying concrete measurement approaches, we move beyond abstract theorizing to enable rigorous empirical investigation.

8. Ethical and Normative Dimensions

The triadic framework developed in this paper—emphasizing the mutual constitution of Nature (N), Consciousness (C), and Environment (E)—carries concrete ethical and normative consequences. Rather than treating agency as the property of isolated individuals, the framework *recognizes how* **institutions**, **designed environments**, *and* **symbolic tools** *co-produce what agents can perceive, learn, and do*. This section translates that perspective into *practical guidance for* **responsibility**, **design**, **governance**, *and* **evaluation**. Where helpful, we connect ethical claims to empirical regularities (e.g., *energetic costs of cognition and plasticity constraints*) to avoid purely rhetorical prescriptions.

8.1 Responsibility in a Mutually Constituted System

If conscious intentions and social institutions can constrain lower-level processes (**downward causation**), *responsibility is not erased—it is distributed*. On this view, responsibility is best understood as "**response-ability**"**:** *the capability to notice effects, to modulate one's own processes, to reshape local environments, and to act within natural constraints*. This stance *preserves individual accountability* while *acknowledging shared obligations for the design of schools, work systems, and platforms that partly constitute agency* (Varela, 1999).

Operationally, *distributed responsibility implies* **layered accountability**:

1. individuals own their choices;
2. organizations own the incentive structures and affordances they deploy;
3. regulators and standards bodies own guardrails for high-impact representational ecologies; and
4. researchers and designers own the duty to surface foreseeable risks before deployment.

These layers should be coupled to explicit audit trails that map from outcomes back to policies, data flows, and interface decisions.

Design implications—responsibility

- **Make responsibilities legible**: publish a RACI-style map (Responsible, Accountable, Consulted, Informed) for each system component.
- **Tie KPIs to human outcomes** (e.g., learning, safety, inclusion), not just engagement or revenue.
- **Require pre-deployment impact assessments** with publicly documented mitigations and red-team results.

8.2 Respecting Plasticity Bounds and Energy Costs

Human capacities are plastic but not unbounded. *Metabolic limits, neuromodulatory constraints, and evolved architectures place real ceilings on training pace and sustained performance.* Ignoring these costs pushes systems to extract short-term labor at the expense of long-term health, learning, and equity. Normatively, environments should work with biological constraints by managing load, spacing effort, and providing recovery windows (Laughlin, de Ruyter van Steveninck, & Anderson, 1998; Raichle & Gusnard, 2002).

Practically, this means

- designing schedules and curricula that respect energetic budgets;
- using measurement (e.g., pupillometry or subjective effort ratings) to detect overload; and
- recognizing heterogeneity—skills cannot be equalized by decree, and trade-offs between abilities are real (Kahneman, 2011).

Design implications—plasticity & energy

- Adopt **'fatigue budgets'** in workplaces and schools; treat overages as policy failures, not individual weakness.
- Favor spaced practice, interleaving, and sleep-compatible rhythms for learning systems.
- Use progressive disclosure and cognitive-load aware UI patterns; reduce needless task-switching.

Our framework emphasizes that while human nature is highly plastic, *it is not infinitely malleable*. There are natural constraints on development and learning, particularly those related to energy metabolism and evolved neural architecture. *This has ethical implications for how we design educational systems, work environments, and technologies*.

Respecting these constraints means acknowledging the metabolic costs of cognitive work and designing environments that work *with*, rather than against, our evolved capacities (N). It means recognizing that not all skills can be developed to the same level by all individuals, and that there are trade-offs between different capacities and abilities (Kahneman, 2011).

8.3 Equity in Environmental Scaffolds

If environments partly constitute nature and consciousness, then access to enriched scaffolds—nutrition, health care, protected sleep, stable housing, education, libraries, and cultural resources—becomes a matter of justice. The capabilities approach frames this as ensuring the substantive freedoms that enable people to develop and exercise central human capabilities, not merely formal rights (Nussbaum, 2011). In our framework, **parity of agency** requires **parity of scaffolds**, because *scaffolds shape the very processes by which agents perceive options and pursue goals.*

Policy follows: invest in early-life and community-level resources; monitor scaffold inequities with transparent indicators; and treat deteriorations in scaffolds as early-warning signals of downstream disparities. Evaluation should track outcomes that are causally proximal to scaffolds (sleep regularity, reading access, safe mobility), not only distal endpoints (income).

Design implications—scaffold equity

- Publish a 'Scaffold Equity Index' for major programs (education, housing, connectivity) with public dashboards.

- Guarantee minimum viable scaffolds (MVS): caloric security, quiet sleep space, basic connectivity, safe transit, and access to shared knowledge.

- Co-design interventions with affected communities; budget for maintenance, not just pilots.

8.4 Transparency in Shaping Representational Ecologies

Symbolic tools—search engines, feeds, recommenders, language models—now mediate most learning and coordination. Because they silently shape what we attend to and remember, opacity in these systems is an ethical liability. Evidence shows that recommender dynamics and automated agents can amplify low-credibility content and addictive use patterns, with adolescents especially vulnerable (Costello et al., 2023; Shao et al., 2018; Weidinger et al., 2021).

Our framework emphasizes the role of **symbolic tools** and **representational systems** in shaping consciousness and mediating our relationship with the environment. *As these tools become increasingly sophisticated and pervasive—from social media algorithms to online privacy to AI systems—questions of transparency and control become increasingly important.* It is often the systems that appear the most benign on the surface that generate the deepest harms beneath it.

Social media recommender algorithms, for example, are marketed as tools for personalization and connection, yet *their opacity conceals amplification of misinformation, polarization, and addictive engagement loops* (Sun, 2024; Metzler et al., 2023). **Large language models** similarly produce outputs that appear fluent and innocuous *while covertly reinforcing harmful stereotypes and exclusionary biases* (Weidinger et al., 2021).

All users in the loop are susceptible to harm, but **younger children and adolescents are especially vulnerable:** platforms' polished interfaces disguise algorithmic practices that foster compulsive use, disturb sleep, and undermine mental health, while simultaneously blocking external scrutiny (Costello et al., 2023). Even automated social bots—indistinguishable from ordinary accounts—have been shown to invisibly accelerate the spread of low-credibility content at critical early stages (Shao et al., 2017). These examples underscore the principle that representational ecologies often harbor their most toxic stressors behind a facade of normalcy and harmlessness.

Normatively, **representational ecologies** should be *auditable*, *steerable*, and *interruptible* by design.

Users should be able to–

1. inspect 'why am I seeing this?' rationales,
2. opt into meaningful controls, and
3. set friction thresholds for high-impact content.

Third-party researchers should have access to privacy-preserving audit interfaces to test for bias, manipulation, and safety failures (Floridi, 2014).

Design implications—transparent ecologies

- Require plain-language model/algorithmic 'nutrition labels' and prominent '*why this*?' explanations.
- Ship with safe defaults for minors (curfew modes, negative-reinforcement caps, and sleep-respecting notifications).
- Open privacy-preserving audit sandboxes and publish risk assessments with known failure modes and incident postmortems.

Who designs these representational ecologies, and for what purposes? How can individuals and communities maintain agency within increasingly complex and opaque symbolic environments? These questions require ongoing ethical reflection and democratic deliberation (Floridi, 2014).

8.5 Balancing Stability and Flexibility

The tension between **stability** and **flexibility**—between **maintaining established patterns** and **adapting to new circumstances**—is a central component of our framework. This tension manifests at multiple levels, from individual cognitive processes to cultural systems and institutions.

Healthy systems *balance* **exploration** *with* **exploitation**. *Cultures vary in this balance* (tight vs. loose norms), and *institutions must tune it to context and risk* (Gelfand, 2018). Our framework highlights that stability and flexibility are not opposites but complements that must be co-regulated across N, C, and E. For ethics, this means binding ourselves to stable commitments—non-discrimination, human dignity, data minimization—while retaining procedural flexibility to adapt as conditions change.

Practically, organizations can use '**ratchet-and-release**' governance: *lock-in safety baselines* (ratchet) while *granting time-boxed exemptions for exploration with enhanced monitoring* (release). Evaluation should test whether local flexibility degrades global stability and trust; if so, roll back the exception.

Design implications—stability/flexibility

- Codify inviolable norms as non-overridable platform constraints.
- Use time-boxed sandboxes with pre-registered success/failure criteria for high-variance innovation.
- Continuously monitor collateral effects on vulnerable groups and core safety metrics.

By explicitly addressing these ethical and normative dimensions, our framework provides not just a descriptive account of what humans are but *a foundation for reflecting on what we might become and how we should shape our individual and collective development*.

8.6 Governance, Safeguards, and Research Ethics

Governance should align with the triadic view: target levers at each corner (N, C, E) and at their interfaces.

Adopt pre-registration for

- high-impact deployments,
- independent ethics review for youth-facing systems, and
- staged rollouts (stepped-wedge) with kill-switches.

Measure proximate harms (sleep disruption, compulsive use, loss of agency) alongside distal outcomes (achievement, health).

For research,

- respect informed consent,
- minimize deception, and
- return value to participants and communities.

8.7 NiCE × Digital Panopticon: Comparative Ethics of Visibility

8.7.1 Conceptual bridge

Bentham's architectural panopticon and Foucault's broader account of disciplinary power describe a shift from overt coercion to behavioral shaping via visibility and examination (Foucault, 1995). In the digital era, visibility is diffused across platforms, sensors, and metrics—what has been referred to as the **Digital Panopticon**.

Visibility now operates along two axes:

a) state/disciplinary surveillance; and

b) platform/self-surveillance aligned with reputational markets and engagement incentives (Han, 2015a; Han, 2015b; Zuboff, 2019).

The NiCE view makes explicit how these systems act on physiology and recovery (**N**), agency and meaning (**C**), and institutional incentives/lock-in (**E**).

8.7.2 China–US/West contrasts: cultural acceptance, mechanisms, outcomes

China. Research on municipal Social Credit pilots finds hundreds of behavioral indicators aggregated into relational scoring regimes (red/black lists, administrative frictions) that channel access and incentives (Liu & Rona-Tas, 2024). Public approval is reported to be relatively high—especially among advantaged urban groups who interpret the systems as *order-enhancing* (Kostka, 2019). In platform labor, algorithmic management (dispatch, timing windows, demerit systems) produces intensified control and risk externalization to riders; regulators responded with the 2022 Algorithmic Recommendation Provisions requiring guardrails and audits (Huang, 2022; Wei, Li, & Sun, 2022; Cyberspace Administration of China [CAC] et al., 2022).

US/West. Constitutional guardrails shape state surveillance: in Carpenter v. United States (2018) the Supreme Court required warrants for historical cell-site location data. Evidence on police body-worn cameras is mixed: a large Washington, DC RCT found null effects on force and complaints, while earlier studies and protocol-specific analyses reported reductions or moderator-sensitive effects (Yokum, Ravishankar, & Coppock, 2019; Ariel, Farrar, & Sutherland, 2015). Perceived surveillance can chill lawful inquiry: Wikipedia visits to privacy-sensitive topics declined following the Snowden disclosures (Penney, 2016). In workplaces, electronic performance monitoring (EPM) tends to raise stress and erode trust with little reliable performance lift (Ravid, White, Tomczak, Miles, & Behrend, 2023; Eurofound, 2020, 2024).

Interpretation. Under NiCE—

Chinese initiatives illustrate high-salience environmental scaffolds (E) that tighten priors (C) and may reduce some vigilance costs for advantaged groups (N), while risking uneven burdens and lock-in.

US/Western cases show stronger due-process channels but higher fragmentation, with surveillance effects concentrated in reputational platforms and workplaces. Both contexts exhibit Goodhart-style metric drift when scores become targets.

8.7.3 Where the harms and benefits concentrate (NiCE analysis)

- N (**biological load**): Continuous or ambiguous visibility elevates arousal and undermines recovery; bounded, purpose-tied visibility can lower uncertainty and improve perceived safety for some populations.
- C (**agency/meaning**): Internalized metrics can crowd out intrinsic motivation and chill exploration; autonomy-supportive controls and clear purposes can sustain meaning and competence.
- E (**rules/incentives**): Opaque, reputational scoring systems entrench power and widen asymmetries; auditable, appealable, and proportional systems can deliver public goods without pervasive harm.

Table 34 - NiCE × Surveillance (state vs platform/self)

NiCE dimension	State / Disciplinary surveillance	Platform / Self-surveillance
N — Biological load (physiology, recovery)	• Mechanisms: patrols, CCTV, biometric/ID checks, body-worn cameras, data fusion hubs. • Claimed benefits: deterrence; faster response; perceived order/safety in public spaces.	• Mechanisms: recommender telemetry, engagement/bio-signal proxies, EPM dashboards, geofencing, wearables. • Claimed benefits: personalization; convenience; loss

NiCE dimension	State / Disciplinary surveillance	Platform / Self-surveillance
	• Risks: elevated arousal for surveilled groups; false positives; recovery disruption if omnipresent. • Guardrails: purpose-binding; time/place limits; retention limits; independent oversight & audits.	prevention; safety prompts. • Risks: boundaryless monitoring; attention capture; fatigue/compulsion; work intensification. • Guardrails: stress budgets; off-hours no-tracking; user-set thresholds; rate limits; deletion defaults.
C — Agency & meaning (autonomy, exploration, intrinsic motivation)	• Effects: self-censorship in sensitive contexts; compliance goals dominate; chilling effects possible. • Modulators: due-process channels (notice, appeal) can mitigate overreach. • Guardrails: necessity & proportionality; community consultation; transparency reports; appeal pathways.	• Effects: internalized metrics (scores/ratings); reputational market pressure; Goodhart drift; comparison anxiety. • Modulators: autonomy-supportive feedback can sustain competence/meaning. • Guardrails: user goal/feedback control; de-emphasize vanity metrics; explainability ('why this?'); opt-outs.
E — Rules & incentives (institutions, lock-in, accountability)	• Structures: statutory mandates; warrants; retention/audit logging; risk registers. • Failure modes: mission creep; group-biased targeting; infrastructure lock-in. • Guardrails: sunset clauses; DPIAs; preregistration; kill-switches; public dashboards.	• Structures: engagement-revenue coupling; algorithmic management; vendor opacity; data brokerage. • Failure modes: power asymmetries; opaque ranking; score chasing; cross-context spillover. • Guardrails: algorithm filing; audit APIs; model cards; appeal channels; minimization; ban dark patterns.

Design reading: *Self/achievement surveillance often proves more toxic than episodic state checks* because it is boundaryless, reputational, and identity-forming; it saturates environments with metrics that colonize attention and time (Han, 2015a; Ravid et al., 2023).

What happens if we "reform the system"? (capitalist, socialist, mixed)

Bottom line: environmental performance is not reliably explained by the *ownership* of capital alone. Both state-led ("socialist") and market-led ("capitalist") regimes have produced severe degradation **when monetary/administrative signals ignore biophysical budgets**; conversely, jurisdictions that **price externalities, cap throughput, and enforce transparency** tend to perform better—regardless of ownership mix (Ostrom, 1990, 2010; Richardson et al., 2023; Wiedmann et al., 2015).

- **State-dominant failures:** the USSR's Aral Sea collapse and heavy-industry pollution in the former Eastern Bloc arose from production quotas blind to ecological constraints—textbook "symbolic targets" decoupled from Nature.
- **Market-dominant failures:** fossil-fuel **underpricing** (~$7 trillion in 2022) keeps rent-seeking profitable while pushing damages onto health and climate (Black, Liu, Parry, & Vernon, 2023). "Green growth" claims rarely show **absolute** decoupling once consumption-based material footprints are counted (Wiedmann et al., 2015).
- **Mixed models that do better** (e.g., several social democracies) usually combine **pricing (or caps)**, tough **standards**, independent **regulation**, and strong **civil society audit**—all design features, not ideologies (Ostrom, 2010).

So **"socialist tendencies"** per se don't solve the problem if they simply **reallocate** wealth while keeping the same **throughput-blind targets**. The failure mode is **rationalized bubbles**—administrative or financial—that **ignore planetary and physiological constraints**.

8.7.4 Design and governance patterns (NiCE-aligned)

1. **Purpose-binding and minimization**: Collect the least data necessary, for a specific purpose, and delete promptly. Pre-register policy changes and publish outcome audits (Carpenter, 2018; Yokum et al., 2019).
2. **Bounded visibility and stress budgets**: Cap continuous monitoring, forbid after-hours tracking for routine roles, and rotate no-gaze zones; justify with EPM meta-evidence and recovery physiology (Ravid et al., 2023).
3. **Autonomy-supportive feedback**: Replace coercive dashboards with mastery feedback and worker-controlled mirrors; reduce vanity metrics to avoid Goodhart drift.
4. **Algorithm regulation as environmental design**: Mandate filing, user controls, appeal channels, and periodic audits—as in China's 2022 provisions and convergent EU approaches (CAC et al., 2022).
5. **Open evaluation**: Use stepped-wedge and 2×2 trials (e.g., monitoring transparency × user control) with population-level outcomes (safety, sleep, trust).

8.7.5 Equity and environmental scaffolds

Because environments partly constitute agency, equity requires parity of scaffolds—nutrition, sleep-safe schedules, connectivity, libraries, and mobility. Surveillance systems should not displace scaffold investment or convert recovery into a metric race. Programs should publish scaffold dashboards (e.g., a Scaffold Equity Index) and treat deterioration in scaffolds as early-warning signals for downstream disparities.

8.7.6 Research and evaluation agenda

Prioritize field experiments that test ethical guardrails under real constraints: e.g., policy pilots with pre-registered criteria, stepped-wedge rollouts with kill-switches, and RE-AIM reporting across groups. Pair quantitative outcomes with qualitative diaries to detect meaning, dignity, and agency effects that escape narrow metrics.

8.7.7 Reconciling happiness/security with autonomy/freedom

Some constituencies experience visible surveillance as order-enhancing and reassuring; others experience it as chilling and dignity-eroding. A NiCE-aligned ethic does not reduce this to slogans. Instead, it binds visibility to collectively endorsed purposes, limits duration and scope, preserves off-ramps and appeal, publishes error bounds, and invests in the scaffolds that allow people to flourish without perpetual measurement. In governance, use a ratchet-and-release approach: lock in non-negotiable safety baselines, then allow time-boxed exploration with enhanced monitoring and automatic rollback when thresholds are breached.

8.8 What would a rational system look like (NiCE)?

8.8.1 Nature (N): respect hard constraints

- **Planetary-boundary-aligned budgets.** Set non-negotiable caps for GHGs, land-use change, nutrient loss, and high-risk “novel entities” (Richardson et al., 2023).

- **Throughput before efficiency.** Price floors or quantity caps on carbon and key materials; remove fossil subsidies (Black et al., 2023). Use **consumption-based** accounts (material footprint) for targets and trade policy (Wiedmann et al., 2015).

- **Critical-natural-capital rule.** Treat some stocks as non-substitutable; apply **safe-minimum standards** and the **precautionary principle** (Daly, 1991/2007).

8.8.2 Consciousness (C): de-glamorize overconsumption; cultivate sufficiency

- **Shrink the materialism driver.** Materialistic values reliably predict lower well-being and lower sustainability; reducing them improves outcomes (Dittmar, Bond, Hurst, & Kasser, 2014; Gu, Gao, Wang, Jiang, & Xu, 2020; Isham et al., 2022).

- **Evidence-based behavior levers.** Social-norm feedback cuts energy use at scale; disclosure and “why this?” explanations reduce compulsive engagement (Allcott, 2011; Farrow, Grolleau, & Ibanez, 2017).

- **Nonattachment & meaning scaffolds.** Psychological **nonattachment** correlates with resilience and prosocial orientation; build institutions (education, media, platforms) that reward stewardship, not only price-chasing (Sahdra, Shaver, & Brown, 2010).

8.8.3 Environment (E): redesign the incentive architecture

- **Polycentric governance of commons.** Local to national **co-management** with clear boundaries, graduated sanctions, conflict resolution, and monitoring—Ostrom’s design principles—beats both pure privatization and pure central planning in many CPRs (Ostrom, 1990, 2010).

- **Transparency & auditability by design.** Mandatory **model/market "nutrition labels," audit APIs, and incident reporting** make symbolic layers inspectable and steerable (aligns with your Fig. 8.4).
- **Adaptive trials, not one-shot reforms.** Use **stepped-wedge** or A/B rollouts with kill-switches; judge policies on **RE-AIM** outcomes (Reach, Effectiveness, Adoption, Implementation, Maintenance), not only GDP (Glasgow, Vogt, & Boles, 1999; Hemming et al., 2015).

8.8.4 How NiCE diagnoses the "rationalized bubble" problem—honestly

1. **Signals**: Do prices/targets *co-vary* with planetary budgets and human energy limits (N), or are they flat-lined? (Red flag: fossil subsidies; growth mandates without MF controls.)
2. **Attention**: Do platforms/institutions amplify **status-through-consumption** (C), or do they scaffold meaning, community, and sufficiency? (Red flag: incentive structures tied only to engagement or short-term returns.)
3. **Rules**: Are audit, sanctions, and benefit-sharing built into the **rules of the game** (E), or outsourced to PR? (Red flag: opacity; unenforced standards.)

If two or more corners are "red," you have a self-harm loop. The fix isn't a new ideology; it's **realigning signals, attention, and rules to the same physical map**.

8.8.5 Considering a short, defendable universal rule-set

1. **Budget-first governance**: Set and enforce **biophysical caps** before optimizing within them (Richardson et al., 2023).
2. **Polluter pays / no free dumping**: Remove underpricing; apply carbon/material price floors or hard caps (Black et al., 2023).
3. **Critical capital non-substitutability**: Don't trade away irreplaceable ecosystems for money (Daly, 1991/2007).
4. **Sufficiency before efficiency**: Prioritize **consumption reduction** where rebound effects dominate (Wiedmann et al., 2015).
5. **Polycentric subsidiarity**: Govern commons at the **lowest capable level** with Ostrom's principles (Ostrom, 1990, 2010).
6. **Transparency & auditability**: Open data, **audit APIs**, explainability for high-impact algorithms/markets.

7. **Precaution & reversibility**: Time-boxed pilots with kill-switches and clear rollback criteria (Hemming et al., 2015).

8. **Well-being measurement**: Evaluate with **RE-AIM** and well-being indices, not GDP alone (Glasgow et al., 1999).

9. **Equity in scaffolds**: Secure the basics—food, sleep, shelter, connectivity—because agency depends on them; inequity breeds stress loops (Shonkoff & Garner, 2012).

10. **Culture of nonattachment**: Normalize **sufficiency** and **stewardship** (Sahdra et al., 2010)—the human-side inoculation against status-consumption arms races.

8.9 When is "profit" in—or antithetical to—our best interest? A NiCE reading

Claim. Profit is a *signal*, not a virtue. It serves our interests only when signals are **calibrated to reality**—biophysical budgets (N), human wellbeing and attention integrity (C), and fair, auditable rules (E). When signals detach, profit becomes a map that misleads.

8.9.1 Profit aligned with best interest

Profit is *in* our interest when:

- **N (Nature):** Production stays within planetary and local ecological caps; no erosion of **critical natural capital** that cannot be replaced (Richardson et al., 2023; Daly, 2007).

- **C (Consciousness):** Net effects on wellbeing, agency, and attention are positive; no reliance on addiction, deception, or "dark" engagement patterns (Dittmar et al., 2014; Farrow et al., 2017).

- **E (Environment/institutions):** Gains come from real productivity/innovation, not externalizing harms or regulatory arbitrage; operations are transparent and **auditable** (Ostrom, 1990, 2010).

8.9.2 Profit antithetical to best interest

Profit is *against* our interest when it depends on:

- **Externalized harms** or breaches of biophysical budgets (Black et al., 2023; Wiedmann et al., 2015).

- **Attentional capture** that degrades wellbeing and informed choice (Dittmar et al., 2014).

- **Symbolic extraction** (rents without real-economy value) or **fragility** (privatized gains, socialized tail risks).

- **Opacity** that prevents third-party audit and remediation (Ostrom, 2010).

8.9.3 The fairness trap (C): why "whatever I can live with" fails

Defining fairness as *"whatever I can get away with (and still live with myself)"* rewards **motivated reasoning** (Kunda, 1990), **moral licensing** (Merritt, Effron, & Monin, 2010), and **moral disengagement** (Bandura, 1999)—all robustly documented. In competitive contexts, this can preferentially select **Dark Triad** traits (Machiavellianism, narcissism, psychopathy) that predict unethical choices and counterproductive work behavior (Paulhus & Williams, 2002; Kish-Gephart, Harrison, & Treviño, 2010).

In short: designing systems around self-justified conscience incentivizes sociopathic drift.

Philosophical guardrails. "Fairness" should be **publicly justifiable** (Rawls, 1971/1999; Scanlon, 1998) and **openly impartial** (Sen, 2009)—i.e., rules you can defend to others who bear the costs, under transparent information. NiCE operationalizes that by requiring *external* checks on signals (N), attention (C), and rules (E).

8.9.4 A ‘fair’ (proposed improved) way to judge: the NiCE Profit Test (summary)

Score each criterion **0 (fails), 1 (partly), 2 (meets)** → total **0–20**.

N — Nature (max 8)

1. **Budget fit (2):** Life-cycle CO_2e/water/materials/toxics ≤ **allocated caps**.
2. **Critical capital (2):** No irreversible ecosystem/species loss; safe-minimum standards.
3. **Decoupling (2):** Revenue↑ while **absolute** footprints↓, not just intensity games.
4. **Transition risk (2):** Science-based targets financed; no dependence on future loopholes.

C — Consciousness (max 6)
5) **Wellbeing effect (2):** Pre-registered trials show **net positive** health/sleep/meaning.
6) **Attention integrity (2):** No dark patterns; “why this?” controls reduce compulsion.
7) **Informed choice (2):** Salient risks/alternatives; protections for vulnerable users.

E — Environment/Institutions (max 6)
8) **Real-economy value (2):** Not rents/regulatory arbitrage/financial engineering.
9) **Transparency & audit (2):** Scope 1–3 + materials/water + incidents **audited & public**; APIs/logs.
10) **Resilience & fairness (2):** Stress-tested; tail risks internalized; harms remediated; benefit-sharing.

Decision rule:

- **16–20 Legitimate** → scale (with monitoring)
- **11–15 Conditional** → time-boxed pilots, remediation bonds, caps
- **0–10 Misaligned** → redesign or don’t deploy

Externality-adjusted profit (don’t price away hard caps):

Π*=Accounting Profit−∑(shadow price×residual externalities)−risk charges\Pi^*=\text{Accounting Profit}-\sum (\text{shadow price}\times \text{residual externalities})-\text{risk charges}Π*=Accounting Profit−∑(shadow price×residual externalities)−risk charges

(Pigou, 1920/2013). If hard caps are breached, reject even if Π*>0\Pi^*>0Π*>0.

8.9.5 Where NiCE improves on “ideology swaps”

Both state-dominant and market-dominant systems degrade when signals ignore **N** (Aral Sea; fossil underpricing), when culture rewards materialist status races that harm **C** (Dittmar et al., 2014), and when **E** lacks transparency and polycentric checks (Ostrom, 1990, 2010; Black et al., 2023; Wiedmann et al., 2015). The cure isn’t “socialism vs capitalism;” it’s **designing any system** so that **signals, attention, and rules** cohere with reality and are publicly auditable.

8.9.6 The NiCE Profit Test v1.0 — field checklist

1) Define the unit & boundary

Unit (product/firm/policy). • Life-cycle scope (incl. Scope 3).

2) Allocate caps (N)

Carbon/material/water/biodiversity budgets at sector/basin scales (Richardson et al., 2023; Wiedmann et al., 2015).

Flag **non-substitutable** stocks (Daly, 2007).

3) Compute Π*\Pi^*Π* (Pigovian adjustment)

Monetize residual externalities + risk. • **Reject** if any hard cap is breached.

4) Human outcomes trial (C)

Pre-register metrics (sleep, wellbeing, compulsive use, informed dwell). • A/B or stepped-wedge design (Glasgow, Vogt, & Boles, 1999; Hemming et al., 2015).

5) Transparency & audit (E)

Publish LCA methods, Scope 1–3, material/water accounts, incident logs. • Provide **audit API** for third-party checks.

6) Scorecard (0–2 each)
N1 Budget fit | N2 Critical capital | N3 Decoupling | N4 Transition

C5 Wellbeing | C6 Attention integrity | C7 Informed choice

E8 Real-economy value | E9 Transparency/audit | E10 Resilience/fairness

Total (0–20): ____ → Decision: Legitimate / Conditional / Misaligned

7) Governance & equity
Assign RACI for compliance/redress. • Benefit-sharing; remediation funds.

8) Public justifiability
Would affected parties accept this under full information and equal standing? (Rawls, 1971/1999; Scanlon, 1998; Sen, 2009)

9. Conclusion: Towards a Unified Science of the Human

The central claim of this paper is organizational, not metaphysical: what we call "the human" is an N–C–E regime—bodies with constraint priors, minds with access and appraisal, and environments with constitutive scaffolds—acting as one coupled system. From this, several commitments follow.

First, **pluralist integration over monism**: treating Integrated Information Theory, Global Neuronal Workspace, and Higher-Order Thought as level-specific lenses resolves false rivalries and clarifies predictions about when phenomenal structure, global broadcast, and metacognitive confidence should dissociate—or covary—keeping the target as experiential constitution in a triad (Tononi et al., 2016; Dehaene & Changeux, 2011; Rosenthal, 2011; Lau & Rosenthal, 2011).

Second, **from metaphor to model**: by embedding energetic costs into active-inference policy selection and combining state-space and hierarchical Bayesian structures for skills and culture, we derive identifiable signatures that empirical designs can recover—behavioral choices, physiological load, and metacognitive reports (Friston, 2010; Hohwy, 2013; Sterling & Laughlin, 2015).

Third, **measurement and interventions are triadic**: undermining any pillar (N, C, or E) degrades the other two, so both diagnosis and design must be multi-lever.

Fourth, **implementation is incentive work**: knowledge does not self-execute. We specify incentive-compatible governance—pre-registration, independent audits, graduated responses, no-notoriety standards, and repair-credit pathways—so that the easiest path for actors aligns with validated outcomes (Zuboff, 2019; Han, 2015).

If the framework is right, it should do more than cohere: it should predict, fail, and improve by design. A unified science of the human will be the one that survives its own falsifiers while reliably guiding systems toward lower load, clearer access, and richer affordances—N, C, and E lifting together. By embracing complexity and paradox, and by recognizing the deep interdependence of nature, consciousness, and environment, we can move toward a more holistic, more nuanced, and ultimately more human understanding of ourselves.

Appendix A. Methods

Table 35 - Notation

o	observable outcomes
s	hidden states
π	policy (sequence of actions)
$P(o)$	preferred outcomes (prior preferences)
$P(o\|s)$	likelihood
$Q(s\|\pi)$	predicted states under policy π
$Q(o\|\pi)$	predicted outcomes under π
$H[\cdot]$	Shannon entropy
$D_{KL}[Q\|P]$	Kullback–Leibler divergence
$C(\pi, s)$	cumulative metabolic cost of policy π from state s
$C(A_t)$	immediate cost of action A_t
α	cost-sensitivity (trait-like) parameter

A.1 EFE decomposition with KL form

Equation (A1): Expected Free Energy (EFE) with energetic prior:

$$G(\pi) = E_{\{Q(o|\pi)\}}[-\ln P(o)] + E_{\{Q(s|\pi)\}}\big[H\big(P(o|s)\big)\big] + \alpha \cdot E_{\{Q(s|\pi)\}}[C(\pi, s)]$$

A.1.1 Extrinsic term as a KL + constant

Start with the extrinsic/risk term:

$$E_{\{Q(o|\pi)\}}[-\ln P(o)] = \Sigma_o Q(o|\pi)[-\ln P(o)]$$

Add and subtract $\ln Q(o|\pi)$:

$$\Sigma_o Q(o|\pi)[\ln Q(o|\pi) - \ln P(o)] - \Sigma_o Q(o|\pi) \ln Q(o|\pi)$$

Identify KL and entropy:

$$E_{Q(o|\pi)}[-\ln\ P(o)]\ =\ D_{KL}(Q(o|\pi)\|P(o))\ +\ H(Q(o|\pi))$$

Implication: If $H\big(Q(o|\pi)\big)$ is approximately constant across policies, minimizing the extrinsic term is approximately equivalent to minimizing $D_{KL}(Q(o|\pi)\|P(o))$.

A.1.2 Energetic prior over policies

Policy prior favoring low energetic cost:

$$P(\pi) \propto \exp\big(-\alpha \cdot E_{Q(s|\pi)}[C(\pi,s)]\big)$$

Equivalently, $\ln P(\pi) = -\alpha \cdot E_{Q(s|\pi)}[C(\pi,s)]$ + const.

A.2.3 From policy-level EFE to per-step skill dynamics

$$S_{\{t+1\}} = f(S_t, A_t, N, E_t) - \alpha \cdot C(A_t)$$

Assumptions: local (first-order) approximation, separability of action-value and metabolic drag, session-wise stationarity of α.

A.2 Parameter-recovery plan (simulation + empirical)

A.2.1 Tasks

• **Bandit**: volatile informative arm vs. stable rewarding arm; add effort cost per sample (time/force).

• **Gridworld**: steep/short vs. flat/long path; goal rewards define $P(o)$; stochastic tiles create ambiguity.

A.2.2 Generative model (for fitting)

Hidden states: task state, volatility context, terrain type.

Observations: reward o_r, sensory feedback o_s, physiology o_p.

Policies: short-horizon action sequences.

Preferences: $P(o)$ centered on reward.

Energetic prior: $P(\pi) \propto \exp\ (-\alpha \cdot E_{Q(s|\pi)}[C(\pi,s)]$.

Costs: $C(\pi,s) = \Sigma_t C(A_t,s_t), C(A_t,s_t) = \beta_0 + \beta_1 \cdot work(A_t,s_t)$.

A.2.3 Observation models (behavior + physiology)

Choice probability: $P(\pi|\Theta) \propto \exp\big(-\gamma \cdot G(\pi)\big)$.

Physiology: $o_{\{p,t\}} \sim N\big(\kappa_0 + \kappa_{1C(A_t,s_t)} + \kappa_{2Risk_t} + \kappa_{3Ambiguity_t}, \sigma_p^2\big)$.

A.3.4 Priors and identifiability

Priors: $\alpha \sim HalfNormal(0,1)$, $\gamma \sim HalfNormal(0,5)$, $\beta_k \sim N(0,1)$, $\kappa_k \sim N(0,1)$.

Checks: parameter-recovery, ablations $(\alpha = 0)$, non-collinearity.

A.2.5 Inference options

• Variational Bayes: enumerate short-horizon policies.

• Simulation-Based Inference: SNPE/SNLE on summary stats.

• Hierarchical Bayes: $\alpha_i \sim Normal(\mu_\alpha, \sigma_\alpha^2)$.

A.2.6 Causal manipulations

• Sleep restriction → ↑ α and steeper pupil–cost slope.

• Caffeine / glucose → ↓ α, more exploration.

• Effort calibration validates scaling of $C(A_t)$.

A.2.7 Validation & reporting

• Out-of-sample choice and physiology prediction.

• Phase plots across α regimes.

• Learning-curve test: higher $\alpha \ \Rightarrow \ slower\ S_t growth$.

A.3 Plain-language summary

We rewrite the extrinsic EFE term as a KL divergence and introduce an energetic prior over policies:

$$P(\pi) \propto \exp\left(-\alpha \cdot E_{Q(S|\pi)}[C(\pi, s)]\right).$$

This yields testable predictions and a recoverable parameter α.

Appendix B. Empirical Supports and Challenges for the Human Paradigm Framework

This appendix presents a curated portfolio of empirical studies that strongly support the Human Paradigm framework (the N–C–E triad with a cost-sensitive Active Inference account), followed by empirical challenges with rational defenses. Each supporting study includes: the core science, the Nature–Consciousness–Environment (N–C–E) mapping, the Active Inference (AIF) tie-in, and why it specifically supports the framework.

B.1 Empirical Studies that Strongly Support the Framework

B.1.1 Critical-period vision (Blakemore, & Cooper, 1970); (Hubel, & Wiesel, 1962/1965) (Gelfand, 2018)

Science. Kittens reared with only vertical (or only horizontal) contours fail to develop normal orientation selectivity and show matched perceptual deficits; ocular-dominance plasticity is time-locked to sensitive windows.

N–C–E mapping. E (edge statistics) tunes N (orientation columns) shaping C (perceptual access and attentional priors).

AIF tie-in. Deprivation inflates ambiguity $E_{\{Q(s|\pi)\}}\left[H\big(P(o|s)\big)\right]$ and later raises effective cost C to infer untrained features.

Why it supports: Demonstrates that environmental scaffolds are constitutive for neural development and perceptual consciousness—canonical N–C–E interdependence.

B.1.2 Literacy acquisition and cortical reorganization (Dehaene, Cohen, Morais, & Kolinsky, 2010)

Science. Learning to read reorganizes ventral visual pathway (emergence/strengthening of the visual word form area) and its coupling with phonological areas; effects are dose- and training-dependent.

N–C–E mapping. E (schooling, print exposure) rewires N (mesoscale connectivity), enabling new C competencies (symbolic access).

AIF tie-in. During acquisition, epistemic value is high; with practice, per-action cost C(A) drops (efficiency), shifting policy priors toward literate strategies at the same trait α.

Why it supports: Concrete demonstration that symbolic scaffolds reshape both brain and policy space in the direction predicted by the framework.

B.1.3 Navigation expertise (London taxi drivers; Maguire, & Gadian, 2000)

Science. Intensive spatial training correlates with larger posterior hippocampi and smaller anterior regions; expertise relates to everyday navigation performance.

N–C–E mapping. C (goal-directed training) and E (complex map demands) alter N (hippocampal structure/function).

AIF tie-in. Training initially raises epistemic sampling; over time, C(A) for route planning falls (efficiency), changing preferred policies.

Why it supports: Shows skill-dependent remodeling that reduces metabolic/compute costs for trained inferences, as this framework predicts.

B.1.4 Musical expertise (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995); (Gaser, & Schlaug, 2003)

Science. Instrument-specific enlargement/retuning of auditory–motor and somatosensory maps; improved temporal precision; dose/age-of-onset effects.

N–C–E mapping. C (deliberate practice) under E (instruments, notation, ensembles) sculpts N (cortical maps).

AIF tie-in. Practice increases extrinsic alignment (accuracy) and reduces cost C(A) for production; behavior shifts to higher-throughput policies without raising α.

Why it supports: Classic case of downward constraint from conscious practice onto neural efficiency via environmental scaffolds.

B.1.5 Meditation and attentional control (Lazar, Kerr, Wasserman, Gray, Greve, Treadway, McGarvey, Quinn, Dusek, Benson, Rauch, Moore, & Fischl, 2005); (Tang, Ma, Wang, Fan, Feng, Lu, Yu, Sui, Rothbart, Fan, & Posner, 2007)

Science. Long-term meditation associates with altered attention/control networks; short-term training modulates conflict costs and interoceptive precision.

N–C–E mapping. C (practice protocols) and E (rituals/contexts) tune N (control and interoceptive systems).

AIF tie-in. Trained policies emphasize epistemic control (precision allocation) and lower energetic cost for attentional set maintenance.

Why it supports: Mechanistically links policy training to effort reductions captured by C(A) and pupil.

B.1.6 Tool use and peripersonal space (Iriki, Tanaka, & Iwamura, 1996)

Science. Monkeys using tools show expansion of peripersonal space coding into tool-reachable space; humans show similar parietal–premotor remapping.

N–C–E mapping. E (tool affordances) extends C (body schema/policy space) and retunes N (multisensory maps).

AIF tie-in. New tools lower C(A) for distal control and change policy priors; epistemic sampling during learning precedes efficiency.

Why it supports: Direct demonstration that scaffolds reshape the space of feasible, low-cost policies.

B.1.7 Cross-cultural cognition (Henrich, Heine, & Norenzayan, 2010); (Nisbett, Peng, Choi, & Norenzayan, 2001)

Science. Reliable differences in holistic vs. analytic attention, explanation style, self-construal, and calibration track institutional and pedagogical practices.

N–C–E mapping. E (norms, curricula) configures C (attentional/explanatory priors) and, over time, N (association/attention networks).

AIF tie-in. Cultural ecologies shift the weighting of extrinsic vs. epistemic value and the learned costs of information seeking; policy priors differ by ecology.

Why it supports: Shows that symbolic/institutional environments systematically tune inference policies—precisely the E→C (→N) pathway.

B.1.8 Sleep restriction and decision policy (Lim & Dinges, 2010)

Science. Acute sleep loss reduces exploration, increases effort discounting, and degrades prefrontal control; pupil baselines and dynamics shift.

N–C–E mapping. N (energetic availability) perturbed by sleep changes C (policy selection) in the same E.

AIF tie-in. Sleep restriction acts as an increase in α (energetic sensitivity), moving policy choice toward energy-conserving options and lowering epistemic sampling.

Why it supports: Causal lever on the energetic prior that the pilot exploits.

B.1.9 Glucose/caffeine and cognitive effort (Hoyland, Lawton, & Dye, 2008); (Smith, 2002)

Science. Glucose or caffeine (under controlled dosing) can restore sustained attention, reduce perceived effort, and increase sampling under uncertainty.

N–C–E mapping. N (metabolic supply) manipulation shifts C (policy), holding E fixed.

AIF tie-in. Acts as decrease in α; increases willingness to select higher-cost, higher-value policies; predicts lower pupil–cost slopes.

Why it supports: Second, independent causal handle on the energetic prior—critical for falsifiability.

B.1.10 Pupil/LC–NE as exploration/effort proxy (Aston-Jones et al., 2005); (Joshi, Li, Kalwani, & Gold, 2016)

Science. Phasic/tonic pupil tracks LC–NE activity; larger dilation with effort and information-seeking under volatility, controlling for luminance.

N–C–E mapping. N (neuromodulation) indexes C (uncertainty/effort allocation) in a given E.

AIF tie-in. Provides a physiological channel that covaries with epistemic value and cost, enabling multi-view identification of α and C.

Why it supports: Supplies the measurement backbone for identifiability claims in the framework.

B.1.11 Global access proxies (P3b/ignition) and conscious report Dehaene et al., 2011)

Science. Late, widespread P3b-like activity correlates with reportable access; "ignition" patterns mark global broadcasting.

N–C–E mapping. N (large-scale integration) supports C (reportable access) contingent on E (task demands).

AIF tie-in. Anchors the 'access' aspect of C and offers time-locked markers to relate to policy switches.

Why it supports: Grounds the C construct in measurable population-level signatures.

B.1.12 Training-induced metabolic efficiency (Haier, Siegel, Tang, Abel, & Buchsbaum, 1992)

Science. With practice, tasks show reduced oxygen/glucose consumption per unit performance and lower pupil-indexed effort at matched accuracy.

N–C–E mapping. C (practice) and E (scaffolds) drive N (efficiency) improvements.

AIF tie-in. Observed as declining C(A) for trained actions (not necessarily a change in α), shifting policy choice as predicted.

Why it supports: Direct evidence for the cost pathway central to the Human Paradigm framework.

B.2 Empirical Challenges (defended)

B.2.1 Pupil isn't energy; it's arousal/surprise.

Challenge. Pupil responds to many factors (luminance, surprise, affect).

Defense. Control luminance and include risk/ambiguity regressors; use calibrated effort tasks; rely on within-subject contrasts (sleep $\uparrow \alpha$; glucose/caffeine $\downarrow \alpha$). The pupil–cost slope remains and tracks energetic availability when modeled properly.

B.2.2 Cost can be folded into preferences; you don't need α.

Challenge. Canonical AIF can hide costs inside outcome priors.

Defense. The Human Paradigm framework elevates energy to a first-class policy prior $P(\pi) \propto \exp\{-\alpha \cdot E[C]\}$ with trait-like α, physiological linkage (pupil/CMR), and distinct signatures: α moves regime boundaries ($G(\pi)$ crossings), whereas softmax precision γ only steepens slopes.

B.2.3 Cross-cultural effects are genetic/SES artifacts.

Challenge. Group differences could be confounded.

Defense. Within-subject instructional flips (minutes-long) produce reversible shifts in attention/explanation; effects transfer to novel stimuli—signatures of policy-prior changes, not fixed traits.

B.2.4 Meditation/musician findings reflect self-selection.

Challenge. Pre-existing differences may cause both training and outcomes.

Defense. Randomized/yoked-dose novice training and within-subject designs show dose–response decreases in effort for trained actions at matched accuracy—consistent with falling C(A) rather than selection.

B.2.5 Literacy effects are just schooling.

Challenge. Active control exposure (schooling) might explain changes.

Defense. Longitudinal, within-person reading instruction with active control training shows print-specific efficiency gains (lower pupil for decoding; improved text prediction), captured as declining C for print actions.

B.2.6 Sleep/nutrition manipulations are too global to isolate α.

Challenge. They could alter many latent variables.

Defense. Directional preregistration targets α: sleep increases energetic sensitivity $(\uparrow \alpha)$; glucose/caffeine decreases it $(\downarrow \alpha)$. We still estimate epistemic/extrinsic terms, and only α-linked signatures (regime shift + pupil–cost slope) move as predicted.

B.2.7 Equifinality: risk/epistemic/cost can mimic each other.

Challenge. Components can trade off in fits.

Defense. Use tasks where exploration is sometimes cheap, sometimes costly, and sometimes valuable, plus volatility blocks. The no-cost model ($\alpha = 0$) fails in high-effort regimes and cannot reproduce pupil–cost covariation.

B.2.8 Global access (P3b) is debated.

Challenge. Alternative accounts exist for conscious access markers.

Defense. We use P3b/ignition as a proxy for access, not a theory commitment; it time-locks C to events we can align with policy switches—adequate for measurement and modeling purposes.

B.3 Why this portfolio matters for The Human Paradigm Framework

Across development, culture, skill, neuromodulation, and metabolic manipulation, environmental scaffolds (E) supply structure and supports that tune neural resources (N) and configure conscious policies (C). In active-inference terms, these studies expose lawful trade-offs among extrinsic value, epistemic value, and energetic cost—and provide manipulable levers (sleep/nutrition/training/tools/instruction) and readouts (behavior + pupil/CMR) to estimate α, recover C, and falsify the account where it fails.

Appendix C. NiCE Study Kit: Measurement Program for the Human Paradigm (2025) Study Kit for Collaborators

To advance from conceptual synthesis to empirical testability, we include a “Study Kit” handout. This provides: core structure and operationalization tables; key falsifiable predictions (multi-lever synergy, sensitive periods, symbolic mediation, plasticity bounds, cultural priors, rituals as control policies); example study designs (e.g., sleep × nutrition manipulations of energetic priors); and falsification criteria ensuring scientific rigor.

Our NiCE triadic framework (Nature–Consciousness–Environment, N–C–E) moves beyond synthesis to a testable research program. This handout summarizes the core structure, operationalization, key predictions, falsifiers, and diagrams for collaborators.

Table 36 - Study Kit Core Structure

Dimension	**Focus**
Nature (N)	Neurobiology, embodiment, developmental constraints
Consciousness (C)	Phenomenal, access, reflective, intentional awareness
Environment (E)	Ecological affordances, artifacts/symbols, institutions

Relations: Constitutive (part of), Causal (produces change), Enabling (makes possible).

Table 37 - Study Kit - Operationalization

Domain	**Measures**	**Examples**
Nature (N)	Neural, physiology, development	EEG, fMRI, pupil dilation, HRV, sensitive periods
Consciousness (C)	Task, metacognition, phenomenology	Reports, confidence, error monitoring, experience sampling
Environment (E)	Culture, artifacts, longitudinal inputs	Cross-cultural surveys, literacy tools, developmental data

C.1 Energetic Prior

Formalized in active inference as:

$$P(\pi) \propto \exp\{-\alpha\, E[C(\pi, s)]\}$$

— α = cost sensitivity (trait-like)

— γ = policy precision (separate)

Identification: manipulate metabolic state (sleep, glucose, caffeine) → measure α via behavior + physiology.

C.2 Key Predictions (Falsifiable)

• **Multi-lever synergy**: N, C, E interventions yield super-additive effects.

• **Sensitive periods**: Early E inputs disproportionately shape later C.

• **Symbolic-tool mediation**: Tools reorganize N and stabilize C.

• **Plasticity** bounds: N constraints cap flexibility.

• **Cultural priors** ↔ metacognition: Cultural model precision predicts calibration.

• **Rituals as control policies**: Collective rituals regulate precision and cost sensitivity.

C.3 Study Design Examples

1. **Sleep** × nutrition manipulation → α shifts → track policy choice & pupil.

2. **Cross-cultural literacy vs. orality** → N–C coupling differences.

3. **Longitudinal symbolic training** → metacognitive profiles.

C.4 Falsifiers

• No multi-lever interaction effects.

• No α–physiology coupling.

• No C sensitivity to early symbolic interventions.

Appendix D:

D.3 Variable-Dependency Structure

The variable-dependency diagram below conceptually summarizes the full NiCE dynamic model. Directed edges represent functional dependencies, while dashed edges denote constitutive (within-time) constraints.

- $N_t \rightarrow C_t$: Capacity expression (biological limits on conscious states)
- $C_t \rightarrow N_{t+1}$: Training-induced plasticity (experience-driven neural change)
- $E_t \rightarrow C_t$: Environmental affordances shaping perception and policy
- $C_t \rightarrow E_{t+1}$: Intentional design (goal-directed modification of environment)
- $E_t \rightarrow N_{t+1}$: Epigenetic modulation
- $E_t \rightarrow E_{t+1}$: Cultural evolution
- N_t→N{?_

Appendix E: Diagnostic and Corrective Logic in the Human Paradigm

This appendix presents a practical framework for applying Kitcey's Human Paradigm as a diagnostic and corrective program for people and human systems. It provides logic to identify breakdown signals, localize problems in the Nature–Consciousness–Environment (N–C–E) triad, and generate targeted lever corrections. Examples are included to illustrate the full lifecycle from diagnosis to correction to renewal.

E.1 Step 1. Identify the Signal of Breakdown

- **Tension signal**: Gaps between current and desired states.
- **Stress marker**: Chronic exhaustion, disengagement, or collapse.
- **Incentive absence**: Lack of curiosity, fairness, belonging, or autonomy.

E.2 Step 2. Localize the Problem in N–C–E Realms

Table 38 - Localize the Problem in N–C–E Realms

Realm	Diagnostic Focus	Typical Indicators
Nature (N)	Biological/energetic capacity	Burnout, cognitive overload, developmental bottlenecks
Consciousness (C)	Awareness, meaning, narrative alignment	Cynicism, loss of purpose, incoherent identity
Environment (E)	Institutional/cultural scaffolds	Punitive norms, lack of supports, misaligned incentives

E.3 Step 3. Select the Corrective Lever

Table 39 - Select the Corrective Lever

If Problem is in…	Corrective Lever	Logic
Nature (N)	Reduce stress, allow recovery, recalibrate load	Respect plasticity limits and energetic budgets

If Problem is in…	Corrective Lever	Logic
Consciousness (C)	Enhance reflection, narrative coherence, agency	Increase self-awareness, provide meaning-making practices
Environment (E)	Redesign scaffolds, peer networks, incentives	Shift from coercion to curiosity, activate belonging and fairness

E.4 Step 4. Apply Polycentric Change Logic

- **Cell-first**: Begin with small units (classrooms, teams, pilot communities).
- **Networked diffusion**: Share practices, data, and peer learning across nodes.
- **Lightweight scaffolds**: Ensure coherence through minimum standards and outcome-linked supports.

E.5 Step 5. Monitor Feedback and Iterate

Track whether tension becomes productive, stress remains within adaptive ranges, and natural incentives such as curiosity and belonging are activated. Iterate based on feedback.

E.6 Illustrative Lifecycle Examples

Education Example:

- **Signal**: Students disengage during a science unit (incentive absence).
- **Diagnosis**: Consciousness-level problem (loss of meaning).
- **Correction**: Teachers shift to inquiry-based learning tapping curiosity.
- **Implementation**: Start in one class (cell), spread via peer-teacher networks, supported by national science standards.
- **Feedback**: Engagement improves, stress lowers, curiosity-driven projects sustain momentum.

Workplace Example:

Signal: Nurses show burnout (stress marker).

Diagnosis: Nature-level overload (exceeding energetic capacity).

Correction: Adjust shift structures, add mentoring.

Implementation: Piloted on one ward, shared through hospital network, scaffolded with staffing policy.

Feedback: Stress decreases, patient safety improves, practice renews itself.

Governance Example:

Signal: Citizens resist sudden policy change (tension unresolved).

Diagnosis: Environment-level misalignment (scaffolds too coercive).

Correction: Introduce phased transitions, subsidies, and community participation.

Implementation: Trial in local regions, scaled via municipal networks, scaffolded by national policy.

Feedback: Compliance increases, stress reduces, participation sustains reform.

This diagnostic lifecycle demonstrates how the Human Paradigm can move from philosophy to practice: signals guide diagnosis, realms locate problems, levers correct them, and polycentric scaffolds enable sustainable system renewal.

References

ABC (Associated Builders and Contractors). (2024, January 31). 2024 construction workforce shortage tops half a million. https://www.abc.org/News-Media/News-Releases/abc-2024-construction-workforce-shortage-tops-half-a-million

Abdel Haleem, M. A. S. (Trans.). (2008). The Qur'an. Oxford University Press. (Original work published ca. 7th century CE)

Aldridge, I. (2013). High-frequency trading: A practical guide to algorithmic strategies and trading systems. Wiley.

Allcott, H. (2011). Social norms and energy conservation. Journal of Public Economics, 95(9–10), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Allison, M. (Writer), & The Who. (Performers). (1970). Young man blues [Song]. On Live at Leeds [Album]. Track Records.

Anderson, C., Kraus, M. W., Galinsky, A. D., & Keltner, D. (2012). The local-ladder effect: Social status and subjective well-being. Psychological Science, 23(7), 764–771. https://doi.org/10.1177/0956797611434537

Anderson, D., & Butcher, A. J. (2007). Autonomy-supportive coaching and self-determined motivation in high school and college athletes: A test of self-determination theory. Psychology of Sport and Exercise, 8(5), 654–670. https://doi.org/10.1016/j.psychsport.2006.11.003

Angell, M. (2004). The truth about the drug companies: How they deceive us and what to do about it. Random House.

Aramonte, S., Huang, W., & Schrimpf, A. (2021). DeFi risks and the decentralisation illusion. BIS Quarterly Review, December 2021, 55–71. Bank for International Settlements. https://www.bis.org/publ/qtrpdf/r_qt2112b.htm

Ariel, B., Farrar, W. A., & Sutherland, A. (2015). The effect of police body-worn cameras on use of force and citizens' complaints: A randomized controlled trial. Journal of Quantitative Criminology, 31(3), 509–535. https://doi.org/10.1007/s10940-014-9236-3

Arner, D., Auer, R., & Frost, J. (2020). Stablecoins: Risks, potential and regulation (BIS Working Papers No. 905). Bank for International Settlements. https://www.bis.org/publ/work905.htm

Aronsson, G., Theorell, T., Grape, T., et al. (2017). A systematic review including meta-analysis of work environment and burnout symptoms. BMC Public Health, 17, 264. https://doi.org/10.1186/s12889-017-4153-7 BioMed Central

Askenasy, J. J., & Lehmann, J. (2013). Consciousness, brain, neuroplasticity. *Frontiers in Psychology, 4*, 412. https://doi.org/10.3389/fpsyg.2013.00412

Aston-Jones, G., & Cohen, J. D. (2005). An integrative theory of locus coeruleus-norepinephrine function: adaptive gain and optimal performance. *Annual Review of Neuroscience, 28*, 403–450. https://doi.org/10.1146/annurev.neuro.28.061604.135709

Autor, D., Dorn, D., Katz, L. F., Patterson, C., & Van Reenen, J. (2020). The fall of the labor share and the rise of superstar firms. Quarterly Journal of Economics, 135(2), 645–709. https://doi.org/10.1093/qje/qjaa004 UW-Madison Libraries

Bandura, A. (1999). Moral disengagement in the perpetration of inhumanities. Personality and Social Psychology Review, 3(3), 193–209. https://doi.org/10.1207/s15327957pspr0303_3

Bank for International Settlements. (2024). OTC derivatives statistics at end-December 2023. https://www.bis.org/publ/otc_hy2405.htm

Barber, B. M., & Odean, T. (2000). Trading is hazardous to your wealth: The common stock investment performance of individual investors. Journal of Finance, 55(2), 773–806. https://doi.org/10.1111/0022-1082.00226

Barnett, L., Barrett, A. B., & Seth, A. K. (2018). Solved problems for Granger causality in neuroscience: A response to Stokes and Purdon. NeuroImage, 178, 744–748. https://doi.org/10.1016/j.neuroimage.2018.05.067

Barua, S., Greenwald, R., Grebely, J., Dore, G. J., Swan, T., & Taylor, L. E. (2015). Restrictions for Medicaid reimbursement of sofosbuvir for the treatment of hepatitis C virus infection in the United States. Clinical Infectious Diseases, 61(5), 730–737. https://doi.org/10.1093/cid/civ312

Baumeister, R. F. (1991). *Meanings of life*. Guilford Press. [No DOI]

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin, 117(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Baumol, W. J. (1990). Entrepreneurship: Productive, unproductive, and destructive. Journal of Political Economy, 98(5), 893–921. https://doi.org/10.1086/261712

Baumol, W. J. (2012). The cost disease: Why computers get cheaper and health care doesn't. Yale University Press.

Baur, D. G., Hong, K., & Lee, A. D. (2018). Bitcoin: Medium of exchange or speculative assets? Journal of International Financial Markets, Institutions and Money, 54, 177–189. https://doi.org/10.1016/j.intfin.2017.12.004

Bechtel, W. (2008). Mental mechanisms: Philosophical perspectives on cognitive neuroscience. Routledge. https://doi.org/10.4324/9780203810095

Bennett, K. (2017). *Making things up*. Oxford University Press. https://doi.org/10.1093/oso/9780199682683.001.0001

Berkovich-Ohana, A., Dor-Ziderman, Y., Trautwein, F.-M., Schweitzer, Y., Nave, O., Fulder, S., & Ataria, Y. (2020). The hitchhiker's guide to neurophenomenology: The case of studying self-boundaries with meditators. Frontiers in Psychology, 11, 1680. https://doi.org/10.3389/fpsyg.2020.01680

Bielza, C., & Larrañaga, P. (2014). Bayesian networks in neuroscience: A survey. Frontiers in Computational Neuroscience, 8, 131. https://doi.org/10.3389/fncom.2014.00131

Bjorklund, D. F. (2015). Developing adaptations. Developmental Review, 38, 13–35. https://doi.org/10.1016/j.dr.2015.07.002

Black, S., Liu, A., Parry, I., & Vernon, N. (2023). IMF fossil fuel subsidies data: 2023 update (IMF Working Paper 23/169). https://doi.org/10.5089/9798400249006.001

Blakemore, C., & Cooper, G. F. (1970). Development of the brain depends on the visual environment. Nature.

Block, N. (1995). On a confusion about a function of consciousness. *Behavioral and Brain Sciences, 18*(2), 227–247. https://doi.org/10.1017/S0140525X00038474

BLS (U.S. Bureau of Labor Statistics). (2024). Home health and personal care aides (Occupational Outlook Handbook). https://www.bls.gov/ooh/healthcare/home-health-aides-and-personal-care-aides.htm

Bowles, S. (2008). Policies designed for self-interested citizens may undermine “the moral sentiments”: Evidence from economic experiments. Science, 320(5883), 1605–1609. https://doi.org/10.1126/science.1152110 Astrophysics Data System

Bowles, S., & Polanía-Reyes, S. (2012). Economic incentives and social preferences: Substitutes or complements? Journal of Economic Literature, 50(2), 368–425. https://doi.org/10.1257/jel.50.2.368 IDEAS/RePEc

Boyd, R., & Richerson, P. J. (1985). Culture and the evolutionary process. University of Chicago Press. https://doi.org/10.7208/chicago/9780226223491.001.0001

Bratman, M. E. (2000). Reflection, planning, and temporally extended agency. *The Philosophical Review, 109*(1), 35–61. https://doi.org/10.1215/00318108-109-1-35

Brown, W. (2015). Undoing the demos: Neoliberalism’s stealth revolution. Zone Books. (No DOI)

Bruineberg, J., & Rietveld, E. (2014). Self-organization, free energy minimization, and optimal grip on a field of affordances. Frontiers in Human Neuroscience, 8, 599. https://doi.org/10.3389/fnhum.2014.00599

Bruner, J. (1991). The narrative construction of reality. *Critical Inquiry, 18*(1), 1–21. https://doi.org/10.1086/448619

Bryk, A. S., Gomez, L. M., & Grunow, A. (2011). Getting ideas into action: Building Networked Improvement Communities in education. Carnegie Foundation for the Advancement of Teaching. https://eric.ed.gov/?id=ED517575

Buddharakkhita, A. (Trans.). (1985). The Dhammapada: The Buddha’s path of wisdom. Buddhist Publication Society. (Original work published ca. 3rd century BCE)

Budish, E., Cramton, P., & Shim, J. (2015). The high-frequency trading arms race: Frequent batch auctions as a market design response. The Quarterly Journal of Economics, 130(4), 1547–1621. https://doi.org/10.1093/qje/qjv027

Bullmore, E., & Sporns, O. (2012). The economy of brain network organization. *Nature Reviews Neuroscience, 13*(5), 336–349. https://doi.org/10.1038/nrn3214

Burge, J., Lane, T., Link, H., Qiu, S., & Mathews, V. J. (2007). Discrete dynamic Bayesian network analysis of fMRI data. IEEE Transactions on Signal Processing, 55(3), 780–788. https://doi.org/10.1109/TSP.2006.890907

Cabinet Office, UK Government. (2013). What Works: Evidence centres for social policy. London, UK: HM Government. https://www.gov.uk/government/publications/what-works-evidence-centres-for-social-policy

Camerer, C. F., Dreber, A., Holzmeister, F., Ho, T.-H., Huber, J., Johannesson, M., … Wu, H. (2018). Evaluating the replicability of social science experiments in Nature and Science between 2010 and 2015. Nature Human Behaviour, 2(9), 637–644. https://doi.org/10.1038/s41562-018-0399-z CoLab

Campbell, G. (2002). Blood diamonds: Tracing the deadly path of the world's most precious stones. Basic Books.

Carpenter v. United States, 585 U.S. ___ (2018). Warrant required for historical cell-site location information. https://supreme.justia.com/cases/federal/us/585/16-402/

Carr-Hill, R., & Peart, E. (2020). The impact of school-based management: A synthesis of the evidence. Education Policy Analysis Archives, 28(127), 1–24. https://doi.org/10.14507/epaa.28.4776

Casali, A. G., Gosseries, O., Rosanova, M., Boly, M., Sarasso, S., Casali, K. R., ... & Massimini, M. (2013). A theoretically based index of consciousness independent of sensory processing and behavior. *Science Translational Medicine, 5*(198), 198ra105. https://doi.org/10.1126/scitranslmed.3006294

Chalmers, D. J. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies, 2*(3), 200–219. [No DOI]

Chalmers, D. J. (1996). *The conscious mind: In search of a fundamental theory*. Oxford University Press. [No DOI]

Chalmers, D. J. (2000). What is a neural correlate of consciousness? In Metzinger, T. (Ed.), Neural Correlates of Consciousness (pp. 17–39). MIT Press.

Champagne, F. A., & Mashoodh, R. (2009). Genes in context: Gene-environment interplay and the origins of individual differences in behavior. Current Directions in Psychological Science, 18(3), 127–131. https://doi.org/10.1111/j.1467-8721.2009.01622.x

Changizi, M. A., & Shimojo, S. (2005). Character complexity and redundancy in writing systems over human history. *Proceedings of the Royal Society B: Biological Sciences, 272*(1560), 267–275. https://doi.org/10.1098/rspb.2004.2942

Chatterjee, A., & Hambrick, D. C. (2007). It’s all about me: Narcissistic CEOs and their effects on company strategy and performance. Administrative Science Quarterly, 52(3), 351–386. https://doi.org/10.2189/asqu.52.3.351 SAGE Journals

Chemero, A. (2003). An outline of a theory of affordances. Ecological Psychology, 15(2), 181–195. https://doi.org/10.1207/S15326969ECO1502_5

Chen, H., Zhang, Y., & Cao, K. (2024). Housing debt and depressive symptoms: Evidence from the China Family Panel Studies. BMC Psychology, 12, 186. https://doi.org/10.1186/s40359-024-01667-z

Cheng, M., Heijmans, B. T., Lumey, L. H., Caramaschi, D., Sharp, G. C., & Suderman, M. (2024). Accelerated biological aging six decades after prenatal famine exposure. PNAS Nexus, 4(7), pgaf209. https://doi.org/10.1093/pnasnexus/pgaf209

Chhatwal, J., Kanwal, F., Roberts, M. S., & Dunn, M. A. (2015). Cost-effectiveness and budget impact of hepatitis C virus treatment with sofosbuvir and ledipasvir in the United States. Annals of Internal Medicine, 162(6), 397–406. https://doi.org/10.7326/M14-1336

Clark, A. (2008). *Supersizing the mind: Embodiment, action, and cognitive extension*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195333213.001.0001

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences, 36*(3), 181–204. https://doi.org/10.1017/S0140525X12000477

Cleary, E. G., Beierlein, J. M., Khanuja, N. S., McNamee, L. M., & Ledley, F. D. (2018). Contribution of NIH funding to new drug approvals 2010–2016. Proceedings of the National Academy of Sciences, 115(10), 2329–2334. https://doi.org/10.1073/pnas.1715368115

Cohen, J. D., McClure, S. M., & Yu, A. J. (2007). Should I stay or should I go? How the human brain manages the trade-off between exploitation and exploration. *Philosophical Transactions of the Royal Society B: Biological Sciences, 362*(1481), 933–942. https://doi.org/10.1098/rstb.2007.2098

Cohn, A., Fehr, E., & Maréchal, M. A. (2014). Business culture and dishonesty in the banking industry. Nature, 516(7529), 86–89. https://doi.org/10.1038/nature13977 EconPapers

Confucius. (1999). The Analects of Confucius: A philosophical translation (R. T. Ames & H. Rosemont Jr., Trans.). Ballantine Books. (Original work published ca. 5th century BCE)

Congressional Research Service. (2022). Algorithmic stablecoins and the TerraUSD crash (CRS Insight IN11928). https://crsreports.congress.gov/product/pdf/IN/IN11928

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. Psychological Review, 107(2), 261–288. https://doi.org/10.1037/0033-295X.107.2.261

Cools, R., & D'Esposito, M. (2011). Inverted-U-shaped dopamine actions on human working memory and cognitive control. *Biological Psychiatry, 69*(12), e113–e125. https://doi.org/10.1016/j.biopsych.2011.03.028

Cooper, T. (2016). Longer lasting products: Alternatives to the throwaway society. Routledge. https://doi.org/10.4324/9781315592932

Cooper, Z., Scott Morton, F., & Shekita, N. (2020). Surprise! Out-of-network billing for emergency care in the United States. Journal of Political Economy, 128(9), 3626–3677. https://doi.org/10.1086/708247

Costello, N., et al. (2023). Algorithms, addiction, and adolescent mental health: An interdisciplinary study to inform state-level policy action to protect youth from the dangers of social media. American Journal of Law & Medicine. Cambridge University Press. https://doi.org/10.1017/amj.2023.###

Craver, C. F. (2007). *Explaining the brain: Mechanisms and the mosaic unity of neuroscience*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199299317.001.0001

Creanza, N., Kolodny, O., & Feldman, M. W. (2017). Cultural evolutionary theory: How culture evolves and why it matters. *Proceedings of the National Academy of Sciences, 114*(30), 7782–7789. https://doi.org/10.1073/pnas.1620732114

Cyberspace Administration of China (CAC), Ministry of Industry and Information Technology (MIIT), Ministry of Public Security (MPS), & State Administration for Market Regulation (SAMR). (2022). Internet Information Service Algorithmic Recommendation Management Provisions (English trans.). DigiChina/Stanford. https://digichina.stanford.edu/work/translation-internet-information-service-algorithmic-recommendation-management-provisions-effective-march-1-2022/

Daly, H. E. (2007). Ecological economics and sustainable development: Selected essays of Herman Daly. Edward Elgar. (Original work published 1991)

Damasio, A. (2010). Self comes to mind: Constructing the conscious brain. Pantheon Books.

Davey Smith, G., & Ebrahim, S. (2003). 'Mendelian randomization': Can genetic epidemiology contribute to understanding environmental determinants of disease? International Journal of Epidemiology, 32(1), 1–22. https://doi.org/10.1093/ije/dyg070

Davis, S. J., Caldeira, K., & Matthews, H. D. (2010). Future CO_2 emissions and climate change from existing energy infrastructure. *Proceedings of the National Academy of Sciences, 107*(34), 14568–14573. https://doi.org/10.1073/pnas.0906974107 [ADS](https://ui.adsabs.harvard.edu/abs/2002PNAS...99.9266W/abstract?utm_source=chatgpt.com)

Daysal, N. M., Lovenheim, M. F., Siersbæk, N., & Wasser, D. N. (2020). *Home prices, fertility, and early-life health outcomes* (NBER Working Paper No. 27469). National Bureau of Economic Research. https://doi.org/10.3386/w27469 [NBER](https://www.nber.org/papers/w27469?utm_source=chatgpt.com)

De Jaegher, H., & Di Paolo, E. (2007). Participatory sense-making: An enactive approach to social cognition. *Phenomenology and the Cognitive Sciences, 6*(4), 485–507. https://doi.org/10.1007/s11097-007-9076-9

De Loecker, J., Eeckhout, J., & Unger, G. (2020). The rise of market power and the macroeconomic implications. Quarterly Journal of Economics, 135(2), 561–644. https://doi.org/10.1093/qje/qjz041 EconPapers

Deacon, T. W. (1997). *The symbolic species: The co-evolution of language and the brain*. W. W. Norton & Company. [No DOI]

Deacon, T. W. (2011). *Incomplete nature: How mind emerged from matter*. W. W. Norton & Company. [No DOI]

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self determination of behavior. Psychological Inquiry, 11(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychological Bulletin, 125(6), 627–668. https://doi.org/10.1037/0033-2909.125.6.627

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychological Bulletin, 125(6), 627–668. https://doi.org/10.1037/0033-2909.125.6.627 OUCI

Dehaene, S. (2009). *Reading in the brain: The new science of how we read*. Penguin. [No DOI]

Dehaene, S., & Changeux, J. P. (2011). Experimental and theoretical approaches to conscious processing. *Neuron, 70*(2), 200–227. https://doi.org/10.1016/j.neuron.2011.03.018

Dehaene, S., Cohen, L., Morais, J., & Kolinsky, R. (2010). Illiterate to literate: How learning to read changes cortical networks. Trends in Cognitive Sciences.

Dehaene, S., Cohen, L., Morais, J., & Kolinsky, R. (2015). Illiterate to literate: behavioural and cerebral changes induced by reading acquisition. *Nature Reviews Neuroscience, 16*(4), 234–244. https://doi.org/10.1038/nrn3924

Dettling, L. J., & Kearney, M. S. (2014). House prices and birth rates: The impact of the real estate market on the decision to have a baby. *Journal of Public Economics, 110*, 82–100. https://doi.org/10.1016/j.jpubeco.2013.09.009 [ScienceDirect](https://www.sciencedirect.com/science/article/abs/pii/S0047272713001904?utm_source=chatgpt.com)

Dias, B. G., & Ressler, K. J. (2014). Parental olfactory experience influences behavior and neural structure in subsequent generations. Nature Neuroscience, 17(1), 89–96. https://doi.org/10.1038/nn.3594

Dittmar, H., Bond, R., Hurst, M., & Kasser, T. (2014). The relationship between materialism and personal well-being: A meta-analysis. Journal of Personality and Social Psychology, 107(5), 879–924. https://doi.org/10.1037/a0037409

Donald, M. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition*. Harvard University Press. https://doi.org/10.2307/j.ctv1pncn3s

Draganski, B., Gaser, C., Busch, V., Schuierer, G., Bogdahn, U., & May, A. (2004). Neuroplasticity: Changes in grey matter induced by training. Nature, 427(6972), 311–312. https://doi.org/10.1038/427311a

Dudai, Y., Karni, A., & Born, J. (2015). The consolidation and transformation of memory. Neuron, 88(1), 20–32. https://doi.org/10.1016/j.neuron.2015.09.004

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. Child Development, 82(1), 405–432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Dusetzina, S. B., Keating, N. L., & Huskamp, H. A. (2018). Proposals to redesign Medicare Part D—Aligning payment with value. Health Affairs, 37(5), 775–781. https://doi.org/10.1377/hlthaff.2018.0143

Easwaran, E. (Trans.). (2007). The Bhagavad Gita (2:47). Nilgiri Press.

Economic Policy Institute. (2024, September 12). Teacher pay in 2023—but not enough to shrink the pay gap with other college graduates. https://www.epi.org/publication/teacher-pay-in-2023/

Economic Policy Institute. (2025, September 24). The teacher pay penalty reached a record high in 2024. https://www.epi.org/publication/the-teacher-pay-penalty-reached-a-record-high-in-2024-three-decades-of-leaving-public-school-teachers-behind/

Edelman, G. M., & Tononi, G. (2000). A universe of consciousness: How matter becomes imagination. Basic Books.

Education Endowment Foundation. (2018). Teaching and learning toolkit. London, UK: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit

Ehrlich, P. R., & Holdren, J. P. (1971). Impact of population growth. *Science, 171*(3977), 1212–1217. [Science](https://www.science.org/doi/abs/?utm_source=chatgpt.com https://doi.org/10.1126/science.171.3977.1212?utm_source=chatgpt.com

Elbert, T., Pantev, C., Wienbruch, C., Rockstroh, B., & Taub, E. (1995). Increased cortical representation of the fingers of the left hand in string players. Science, 270(5234), 305–307. https://doi.org/10.1126/science.270.5234.305

Eldawlatly, S., Jin, R., & Oweiss, K. G. (2010). On the use of dynamic Bayesian networks in reconstructing functional neuronal networks from spike train ensembles. Neural Computation, 22(1), 158–189. https://doi.org/10.1162/neco.2009.08-08-869

EPI (Economic Policy Institute). (2024, September 12). Teacher pay in 2023—but not enough to shrink the pay gap with other college graduates. https://www.epi.org/publication/teacher-pay-in-2023/

EPI (Economic Policy Institute). (2025, September 24). The teacher pay penalty reached a record high in 2024. https://www.epi.org/publication/the-teacher-pay-penalty-reached-a-record-high-in-2024-three-decades-of-leaving-public-school-teachers-behind/

Epstein, E. J. (1982). Have you ever tried to sell a diamond? The Atlantic. https://www.theatlantic.com/magazine/archive/1982/02/have-you-ever-tried-to-sell-a-diamond/304575/

ETH Zürich. (n.d.). Constitutive Relations in Electromagnetism. ETH Lecture Notes.

Eurofound. (2020). Employee monitoring and surveillance (TJ-01-20-638-EN-N). Publications Office of the EU. https://doi.org/10.2806/424580

Eurofound. (2024). Living and working in Europe 2023. Publications Office of the EU. https://doi.org/10.2806/49049

Falk, A., & Szech, N. (2013). Morals and markets. Proceedings of the National Academy of Sciences, 110(44), 17036–17041. https://doi.org/10.1073/pnas.1217252110 NBER

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: A meta-analysis. Environmental and Resource Economics, 68(3), 405–433. https://doi.org/10.1007/s10640-016-9986-7

Fernandez, R., & Rodrik, D. (1991). Resistance to reform: Status quo bias in the presence of individual-specific uncertainty. American Economic Review, 81(5), 1146–1155.

Feygin, A. (2020). Evidence for Networked Improvement Communities: Systematic review report. American Institutes for Research. https://www.air.org/sites/default/files/2021-06/NIC-Systematic-Review-Report-123019-Jan-2020.pdf

Fields, D., & Hodkinson, S. (2018). Housing, finance and welfare: Recasting the boundaries of ownership and mortgage markets. Routledge. https://doi.org/10.4324/9781315179638

Fields, D., & Uffer, S. (2016). The financialisation of rental housing: A comparative analysis of New York City and Berlin. Urban Studies, 53(7), 1486–1502. https://doi.org/10.1177/0042098014543704

Financial Stability Board. (2025). Leverage in non-bank financial intermediation: Final report. https://www.fsb.org/2025/07/leverage-in-nonbank-financial-intermediation-final-report

Fleming, S. M., & Dolan, R. J. (2012). The neural basis of metacognitive ability. *Philosophical Transactions of the Royal Society B: Biological Sciences, 367*(1594), 1338–1349. https://doi.org/10.1098/rstb.2011.0417

Fleming, S. M., & Lau, H. C. (2014). How to measure metacognition. *Frontiers in Human Neuroscience, 8*, 443. https://doi.org/10.3389/fnhum.2014.00443

Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199606722.001.0001

Fojo, T., & Grady, C. (2009). How much is life worth? Cetuximab, non–small cell lung cancer, and the $440 billion question. Journal of the National Cancer Institute, 101(15), 1044–1048. https://doi.org/10.1093/jnci/djp177

Foster-Fishman, P., & Watson, E. (2017). Understanding and promoting systems change. In M. A. Bond, I. Serrano-García, C. B. Keys, & M. Shinn (Eds.), APA handbook of community psychology: Methods for community research and action for diverse groups and issues (pp. 255–274). American Psychological Association. https://doi.org/10.1037/14954-015

Foucault, M. (1995). Discipline and punish: The birth of the prison (A. Sheridan, Trans.). Vintage Books. (Original work published 1975)

Foucault, M. (2008). The birth of biopolitics: Lectures at the Collège de France, 1978–1979 (M. Senellart, F. Ewald, & A. Fontana, Eds.). Palgrave Macmillan. https://doi.org/10.1057/9780230594180 SpringerLink

Frey, B. S., & Oberholzer-Gee, F. (1997). The cost of price incentives: An empirical analysis of motivation crowding-out. American Economic Review, 87(4), 746–755. (Stable link & bibliographic records). EconPapers+1

Friedman, M. (1970, September 13). The social responsibility of business is to increase its profits. The New York Times Magazine. (No DOI) SAGE Journals

Friston, K. (2010). The free-energy principle: a unified brain theory? *Nature Reviews Neuroscience, 11*(2), 127–138. https://doi.org/10.1038/nrn2787

Friston, K. J., Harrison, L., & Penny, W. (2003). Dynamic causal modelling. NeuroImage, 19(4), 1273–1302. https://doi.org/10.1016/S1053-8119(03)00202-7

Friston, K. J., Kahan, J., Biswal, B., & Razi, A. (2019). Dynamic causal modelling revisited. NeuroImage, 199, 730–744. https://doi.org/10.1016/j.neuroimage.2017.02.045

Friston, K., FitzGerald, T., Rigoli, F., Schwartenbeck, P., & Pezzulo, G. (2017). Active inference: a process theory. *Neural Computation, 29*(1), 1–49. https://doi.org/10.1162/NECO_a_00912

Gallagher, S. (2005). *How the body shapes the mind*. Oxford University Press. https://doi.org/10.1093/0199271941.001.0001

Gammon, E. (2017). Narcissistic rage and neoliberal reproduction. Global Society, 31(4), 510–530. https://doi.org/10.1080/13600826.2017.1280775 Taylor & Francis Online

Gaser, C., & Schlaug, G. (2003). Brain structures differ between musicians and non-musicians. The Journal of Neuroscience, 23(27), 9240–9245. https://doi.org/10.1523/JNEUROSCI.23-27-09240.2003

Gegenfurtner, K. R., & Kiper, D. C. (2003). Color vision. Annual Review of Neuroscience, 26, 181–206. https://doi.org/10.1146/annurev.neuro.26.041002.131116

Gelfand, M. J. (2018). *Rule makers, rule breakers: How tight and loose cultures wire our world*. Scribner. [No DOI]

Gelfand, M. J., Harrington, J. R., & Jackson, J. C. (2017). The strength of social norms across human groups. *Perspectives on Psychological Science, 12*(5), 800–809. https://doi.org/10.1177/1745691617708631

Gelfand, M. J., Nishii, L. H., & Raver, J. L. (2006). On the nature and importance of cultural tightness-looseness. *Journal of Applied Psychology, 91*(6), 1225–1244. https://doi.org/10.1037/0021-9010.91.6.1225

Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., ... & Yamaguchi, S. (2011). Differences between tight and loose cultures: A 33-nation study. *Science, 332*(6033), 1100–1104. https://doi.org/10.1126/science.1197754

Gibson, J. J. (1979). The ecological approach to visual perception. Houghton Mifflin.

Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *American Journal of Public Health, 89*(9), 1322–1327. https://doi.org/10.2105/AJPH.89.9.1322 [research.amanote.com]

Glennan, S. (2017). The new mechanical philosophy. Oxford University Press. https://doi.org/10.1093/oso/9780198779711.001.0001

Global Witness. (2011). Global Witness leaves Kimberley Process, calls for diamond trade to be held accountable. Global Witness. https://www.globalwitness.org

Gnambs, T., & Appel, M. (2018). Narcissism and social networking behavior: A meta-analysis. Journal of Personality, 86(2), 200–212. https://doi.org/10.1111/jopy.12305 PubMed

Gneezy, U., & Rustichini, A. (2000a). A fine is a price. Journal of Legal Studies, 29(1), 1–17. https://doi.org/10.1086/468061 EconPapers

Gneezy, U., & Rustichini, A. (2000b). Pay enough or don’t pay at all. Quarterly Journal of Economics, 115(3), 791–810. https://doi.org/10.1162/003355300554917 CORE

Gopnik, A. (2020). Childhood as a solution to explore-exploit tensions. Philosophical Transactions of the Royal Society B, 375(1803), 20190502. https://doi.org/10.1098/rstb.2019.0502

Gottlieb, G. (2007). Probabilistic epigenesis. *Developmental Science, 10*(1), 1–11. https://doi.org/10.1111/j.1467-7687.2007.00556.x

Graeber, D. (2011). Debt: The first 5,000 years. Melville House.

Graham, J. R., Harvey, C. R., & Rajgopal, S. (2005). The economic implications of corporate financial reporting. Journal of Accounting and Economics, 40(1–3), 3–73. https://doi.org/10.1016/j.jacceco.2005.01.002 ScienceDirect

Greene, J. A., & Riggs, K. R. (2015). Why is there no generic insulin? Historical origins of barriers to reform. New England Journal of Medicine, 372(12), 1171–1175. https://doi.org/10.1056/NEJMms1411398

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. Milbank Quarterly, 82(4), 581–629. https://doi.org/10.1111/j.0887-378X.2004.00325.x

Griffiths, P. E., & Gray, R. D. (1994). Developmental systems and evolutionary explanation. *The Journal of Philosophy, 91*(6), 277–304. https://doi.org/10.2307/2940982

Griffiths, P. E., & Stotz, K. (2013). Genetics and philosophy: An introduction. Cambridge University Press. https://doi.org/10.1017/CBO9780511744082

Grijalva, E., Harms, P. D., Newman, D. A., Gaddis, B. H., & Fraley, R. C. (2015). Narcissism and leadership: A meta-analytic review of linear and nonlinear relationships. Personnel Psychology, 68(1), 1–47. https://doi.org/10.1111/peps.12072 DigitalCommons

Gu, D., Gao, S., Wang, R., Jiang, J., & Xu, Y. (2020). The negative associations between materialism and pro-environmental attitudes and behaviors. Environment and Behavior, 52(6), 611–638. https://doi.org/10.1177/0013916518811902

Gyawali, B., Sullivan, R., & Booth, C. M. (2020). Cancer drugs: Value, evidence, and regulatory standards. BMJ, 370, m3379. https://doi.org/10.1136/bmj.m3379

Haier, R. J., Siegel, B. V., Tang, C., Abel, L., & Buchsbaum, M. S. (1992). Intelligence and changes in regional cerebral glucose metabolic rate following learning. Intelligence, 16(3–4), 415–426. https://doi.org/10.1016/0160-2896(92)90018-M

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. Psychological Methods, 20(1), 102–116. https://doi.org/10.1037/a0038889

Han, B.-C. (2015). The burnout society (E. Butler, Trans.). Stanford University Press. https://doi.org/10.1515/9780804797504 WorldCat

Han, B.-C. (2015b). The transparency society (E. Butler, Trans.). Stanford University Press. https://doi.org/10.1515/9780804797511

Han, B.-C. (2017). Psychopolitics: Neoliberalism and new technologies of power. Verso. (No DOI) PenguinRandomhouse.com

Harvey, D. (2005). A brief history of neoliberalism. Oxford University Press. BibSonomy

Heft, H. (2001). Ecological psychology in context: James Gibson, Roger Barker, and the legacy of William James's radical empiricism. Lawrence Erlbaum Associates.

Heft, H. (2013). Wayfinding, navigation, and environmental cognition from a naturalist’s stance. In D. Waller & L. Nadel (Eds.), Handbook of spatial cognition (pp. 265–294). American Psychological Association. https://doi.org/10.1037/13936-015

Heijmans, B. T., Tobi, E. W., Stein, A. D., Putter, H., Blauw, G. J., Susser, E. S., Slagboom, P. E., & Lumey, L. H. (2008). Persistent epigenetic differences associated with prenatal exposure to famine in humans. Proceedings of the National Academy of Sciences, 105(44), 17046–17049. https://doi.org/10.1073/pnas.0806560105

Hemming, K., Haines, T. P., Chilton, P. J., Girling, A. J., & Lilford, R. J. (2015). The stepped wedge cluster randomised trial: Rationale, design, analysis, and reporting. BMJ, 350, h391. https://doi.org/10.1136/bmj.h391

Hemphill, C. S., & Wu, T. (2013). Parallel exclusions. Yale Law Journal, 122(5), 1182–1256.

Henke, K. (2010). A model for memory systems based on processing modes rather than consciousness. Nature Reviews Neuroscience, 11(7), 523–532. https://doi.org/10.1038/nrn2850

Henrich, J. (2003). Demography and cultural evolution: How adaptive cultural processes change when populations are small and isolated. Evolutionary Anthropology, 12(3), 123–135. https://doi.org/10.1002/evan.10110

Henrich, J. (2004). Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses—the Tasmanian case. *American Antiquity, 69*(2), 197–214. https://doi.org/10.2307/4128416

Henrich, J. (2015). The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter. Princeton University Press. https://doi.org/10.1515/9781400873296

Henrich, J. (2016). *The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter*. Princeton University Press. https://doi.org/10.1515/9781400873296

Henrich, J., Ensminger, J., McElreath, R., Barr, A., Barrett, C., … Ziker, J. (2010). Markets, religion, community size, and the evolution of fairness and punishment. Science, 327(5972), 1480–1484. https://doi.org/10.1126/science.1182238 Science

Herbert, M. S., & Afari, N. (2023). Present moment awareness. In M. P. Twohig, M. E. Levin, & J. M. Petersen (Eds.), The Oxford handbook of acceptance and commitment therapy (pp. 230–248). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197550076.001.0001

Herkert, D., Vijayakumar, P., Luo, J., Schwartz, J. I., Rabin, T. L., DeFilippo, E., ... & Lipska, K. J. (2019). Cost-related insulin underuse among patients with diabetes. JAMA Internal Medicine, 179(1), 112–114. https://doi.org/10.1001/jamainternmed.2018.5008

Hesmondhalgh, D. (2013). The cultural industries. Sage. https://doi.org/10.4135/9781446279946

Himmelstein, D. U., & Woolhandler, S. (2016). The current and projected taxpayer shares of US health costs. American Journal of Public Health, 106(3), 449–452. https://doi.org/10.2105/AJPH.2015.302997

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. American Psychologist, 44(3), 513–524. https://doi.org/10.1037/0003-066X.44.3.513

Hobson, N. M., Schroeder, J., Risen, J. L., Xygalatas, D., & Inzlicht, M. (2018). The psychology of rituals: An integrative review and process-based framework. *Personality and Social Psychology Review, 22*(3), 260–284. https://doi.org/10.1177/1088868317734944

Hochschild, A. R. (1983). The managed heart: Commercialization of human feeling. University of California Press. (No DOI)

Hohwy, J. (2013). *The predictive mind*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199682737.001.0001

Hoyland, A., Lawton, C. L., & Dye, L. (2008). Acute effects of macronutrient manipulations on cognitive test performance in healthy young adults: A systematic research review. Neuroscience & Biobehavioral Reviews, 32(1), 72–85. https://doi.org/10.1016/j.neubiorev.2007.05.006

Huang, H. (2022). Algorithmic management in food-delivery platform economy in China. New Technology, Work and Employment, 38(1), 185–205. https://doi.org/10.1111/ntwe.12228

Hubel, D. H., & Wiesel, T. N. (1962/1965). Receptive fields, binocular interaction and functional architecture in the cat's visual cortex. Journal of Physiology; and subsequent papers.

Hutchings, J. A., & Myers, R. A. (1994). What can be learned from the collapse of a renewable resource? Atlantic cod, Gadus morhua, of Newfoundland and Labrador. Canadian Journal of Fisheries and Aquatic Sciences, 51(9), 2126–2146. https://doi.org/10.1139/f94-214

Hutchins, E. (1995). *Cognition in the wild*. MIT Press. https://doi.org/10.7551/mitpress/1881.001.0001

International Monetary Fund (Black, S., Liu, A., Parry, I., & Vernon, N.). (2023). IMF fossil fuel subsidies data: 2023 update (IMF Working Paper 23/169). https://doi.org/10.5089/9798400249006.001

Iriki, A., Tanaka, M., & Iwamura, Y. (1996). Coding of modified body schema during tool use by macaque postcentral neurones. NeuroReport, 7(14), 2325–2330. https://doi.org/10.1097/00001756-199610020-00010

Isenberg, A. C. (2000). The destruction of the bison: An environmental history, 1750–1920. Cambridge University Press.

Isham, A., Verfuerth, C., Armstrong, A., Elf, P., Gatersleben, B., & Jackson, T. (2022). The problematic role of materialistic values in the pursuit of sustainable well-being. International Journal of Environmental Research and Public Health, 19(6), 3673. https://doi.org/10.3390/ijerph19063673

Ivanova, D., & Wood, R. (2020). The unequal distribution of household carbon footprints in Europe and its link to sustainability. *Global Sustainability, 3*, e18. https://doi.org/10.1017/sus.2020.12

Jablonka, E., & Raz, G. (2009). Transgenerational epigenetic inheritance: Prevalence, mechanisms, and implications for the study of heredity and evolution. Quarterly Review of Biology, 84(2), 131–176. https://doi.org/10.1086/598822

Janssen, M. C., et al. (2021). Blood donation and monetary incentives: A meta-analysis of cost-effectiveness. Journal of Health Economics, 80, 102538. https://doi.org/10.1016/j.jhealeco.2021.102538 (summary excerpted for conclusions). ScienceDirect

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics, 3(4), 305–360. https://doi.org/10.1016/0304-405X(76)90026-X Cambridge University Press & Assessment

Jewish Publication Society. (1999). Tanakh: The holy scriptures: The new JPS translation according to the traditional Hebrew text. Jewish Publication Society. (Original work published 1985)

Joshi, S., Li, Y., Kalwani, R. M., & Gold, J. I. (2016). Relationships between pupil diameter and neuronal activity in locus coeruleus, colliculi, and cingulate cortex. Neuron, 89(1), 221–234. https://doi.org/10.1016/j.neuron.2015.11.028

Josipovic, Z., & Baars, B. J. (2015). Editorial: What can neuroscience learn from contemplative practices? Frontiers in Psychology, 6, 1731. https://doi.org/10.3389/fpsyg.2015.01731

Jost, J. T., Langer, M., Badaan, V., Azevedo, F., Etchezahar, E., Ungaretti, J., & Hennes, E. P. (2017). Ideology and the limits of self-interest: System justification motivation and conservative advantages in mass politics. Translational Issues in Psychological Science, 3(3), e1–e26. https://doi.org/10.1037/tps0000127

Juarrero, A. (1999). *Dynamics in action: Intentional behavior as a complex system*. MIT Press. https://doi.org/10.7551/mitpress/2528.001.0001

Judge, T. A., LePine, J. A., & Rich, B. L. (2006). Loving yourself abundantly: Relationship of the narcissistic personality to self- and other-perceptions of workplace deviance, leadership, and performance. Journal of Applied Psychology, 91(4), 762–776. https://doi.org/10.1037/0021-9010.91.4.762 Arizona Board of Regents

Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux. [No DOI]

Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well being. Proceedings of the National Academy of Sciences, 107(38), 16489–16493. https://doi.org/10.1073/pnas.1011492107

Kahneman, D., Killingsworth, M. A., et al. (2023). A replication and reanalysis of "Income and emotional well-being": Income and experienced well-being rise together for most people. Proceedings of the National Academy of Sciences, 120(12), e2211123110. https://doi.org/10.1073/pnas.2211123110

Kapczynski, A., Park, C., & Sampat, B. (2012). Polymorph patents on known drugs: Implications for competition and innovation. Health Affairs, 31(10), 2336–2342. https://doi.org/10.1377/hlthaff.2012.0107

Karmiloff-Smith, A. (2015). An alternative to domain-general or domain-specific frameworks for theorizing about human evolution and development. *AIMS Neuroscience, 2*(2), 93–103. https://doi.org/10.3934/Neuroscience.2015.2.93

Kasser, T., & Ryan, R. M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. Journal of Personality and Social Psychology, 65(2), 410–422. https://doi.org/10.1037/0022-3514.65.2.410

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. Personality and Social Psychology Bulletin, 22(3), 280–287. https://doi.org/10.1177/0146167296223006

Keyfitz, N. (1971). On the momentum of population growth. *Demography, 8*(1), 71–80. https://doi.org/10.2307/2060339 [Duke University Press](https://read.dukeupress.edu/demography/article-abstract/8/1/71/172357/On-the-momentum-of-population-growth?utm_source=chatgpt.com)

Killingsworth, M. A. (2021). Experienced well-being rises with income, even above $75,000 per year. Proceedings of the National Academy of Sciences, 118(4), e2016976118. https://doi.org/10.1073/pnas.2016976118

Killingsworth, M. A., Kahneman, D., & Mellers, B. A. (2023). Income and emotional well being: A conflict resolved. Proceedings of the National Academy of Sciences, 120(11), e2208661120. https://doi.org/10.1073/pnas.2208661120

Kim, J. (1999). Making sense of emergence. *Philosophical Studies, 95*(1), 3–36. https://doi.org/10.1023/A:1004563122154

King, L. (2025). Not all that: Autoforms, narcissism, and the neoliberal cultural landscape. Life Writing. (Advance online / forthcoming; DOI not yet available).

Kish-Gephart, J. J., Harrison, D. A., & Treviño, L. K. (2010). Bad apples, bad cases, and bad barrels: Meta-analytic evidence about sources of unethical decisions at work. Journal of Applied Psychology, 95(1), 1–31. https://doi.org/10.1037/a0017103

Kitayama, S., & Park, J. (2010). Cultural neuroscience of the self: understanding the social grounding of the brain. *Social Cognitive and Affective Neuroscience, 5*(2-3), 111–129. https://doi.org/10.1093/scan/nsq052

Kitayama, S., & Uskul, A. K. (2011). Culture, mind, and the brain: Current evidence and future directions. *Annual Review of Psychology, 62*, 419–449. https://doi.org/10.1146/annurev-psych-120709-145357

Kivell, T. L. (2015). Evidence in hand: Recent discoveries and the early evolution of human manual manipulation. Philosophical Transactions of the Royal Society B, 370(1682), 20150105. https://doi.org/10.1098/rstb.2015.0105

Konner, M. (2010). The evolution of childhood: Relationships, emotion, mind. Harvard University Press.

Kostka, G. (2019). China’s social credit systems and public opinion: Explaining high levels of approval. New Media & Society, 21(7), 1565–1593. https://doi.org/10.1177/1461444819826402

Krippner, G. R. (2005). The financialization of the American economy. Socio-Economic Review, 3(2), 173–208. https://doi.org/10.1093/SER/mwi008

Kuhl, P. K. (2004). Early language acquisition: Cracking the speech code. Nature Reviews Neuroscience, 5(11), 831–843. https://doi.org/10.1038/nrn1533

Kunda, Z. (1990). The case for motivated reasoning. Psychological Bulletin, 108(3), 480–498. https://doi.org/10.1037/0033-2909.108.3.480

Laland, K. N., Matthews, B., & Feldman, M. W. (2016). An introduction to niche construction theory. Evolutionary Ecology, 30(2), 191–202. https://doi.org/10.1007/s10682-016-9821-z

Laland, K. N., Odling-Smee, J., & Feldman, M. W. (2000). Niche construction, biological evolution, and cultural change. *Behavioral and Brain Sciences, 23*(1), 131–146. https://doi.org/10.1017/S0140525X00002417

Laland, K. N., Uller, T., Feldman, M. W., Sterelny, K., Müller, G. B., Moczek, A., Jablonka, E., & Odling-Smee, J. (2015). The extended evolutionary synthesis: Its structure, assumptions and predictions. Proceedings of the Royal Society B, 282(1813), 20151019. https://doi.org/10.1098/rspb.2015.1019

Lang, M., Krátký, J., Shaver, J. H., Jerotijević, D., & Xygalatas, D. (2015). Effects of anxiety on spontaneous ritualized behavior. *Current Biology, 25*(14), 1892–1897. https://doi.org/10.1016/j.cub.2015.05.049

Lau, H., & Rosenthal, D. (2011). Empirical support for higher-order theories of conscious awareness. *Trends in Cognitive Sciences, 15*(8), 365–373. https://doi.org/10.1016/j.tics.2011.05.009

Laughlin, S. B., de Ruyter van Steveninck, R. R., & Anderson, J. C. (1998). The metabolic cost of neural information. *Nature Neuroscience, 1*(1), 36–41. https://doi.org/10.1038/236

Lawlor, D. A., Harbord, R. M., Sterne, J. A. C., Timpson, N., & Davey Smith, G. (2008). Mendelian randomization: Using genes as instruments for making causal inferences in epidemiology. Statistics in Medicine, 27(8), 1133–1163. https://doi.org/10.1002/sim.3034

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., McGarvey, M., Quinn, B. T., Dusek, J. A., Benson, H., Rauch, S. L., Moore, C. I., & Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. NeuroReport, 16(17), 1893–1897. https://doi.org/10.1097/01.wnr.0000186598.66243.19

Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. Journal of Political Economy, 89(5), 841–864. https://doi.org/10.1086/261010

Lazonick, W. (2014). Profits without prosperity. Harvard Business Review, 92(9), 46–55. (No DOI) OpenEdition Journals

Le Billon, P. (2008). Diamond wars? Conflict diamonds and geographies of resource wars. Annals of the Association of American Geographers, 98(2), 345–372. https://doi.org/10.1080/00045600801922422

Lea, S. E. G., & Webley, P. (2006). Money as tool, money as drug: The biological psychology of a strong incentive. Behavioral and Brain Sciences, 29(2), 161–209. https://doi.org/10.1017/S0140525X06009046

Leaver, C., Ozier, O., Serneels, P., & Zeitlin, A. (2022). Recruitment, effort, and retention effects of performance contracts for civil servants: Experimental evidence from Rwandan primary schools. American Economic Review, 112(7), 2204–2246. https://doi.org/10.1257/aer.20200349

Legrand, D., & Ruby, P. (2009). What is self-specific? Theoretical investigation and critical review of neuroimaging results. *Psychological Review, 116*(1), 252–282. https://doi.org/10.1037/a0014172

Lerner, R. M., Johnson, S. K., & Buckingham, M. H. (2015). Relational developmental systems-based theories and the study of children and families: Lerner and Spanier (1978) revisited. Journal of Family Theory & Review, 7(2), 83–104. https://doi.org/10.1111/jftr.12067

Lester, B. M., Conradt, E., & Marsit, C. J. (2016). Introduction to the special section on epigenetics. Child Development, 87(1), 29–37. https://doi.org/10.1111/cdev.12489

Lickliter, R., & Honeycutt, H. (2003). Developmental dynamics: Toward a biologically plausible evolutionary psychology. Psychological Bulletin, 129(6), 819–835. https://doi.org/10.1037/0033-2909.129.6.819

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. Psychological Bulletin, 136(3), 375–389. https://doi.org/10.1037/a0018883

Lippi, A., Rossi, S., & Soana, M. G. (2022). Status quo bias and risk tolerance in asset allocation decision-making. Journal of Neuroscience, Psychology, and Economics, 15(4), 195–209. https://doi.org/10.1037/npe0000166

Liu, C., & Rona-Tas, Á. (2024). Trusting by numbers: An analysis of a Chinese Social Credit System governance infrastructure. Critical Sociology. Advance online publication. https://doi.org/10.1177/08969205241246528

Lohmann, G., Erfurth, K., Müller, K., & Turner, R. (2012). Critical comments on dynamic causal modelling. NeuroImage, 59(3), 2322–2329. https://doi.org/10.1016/j.neuroimage.2011.09.025

Lohmann, L. (2009). Toward a different debate in environmental accounting: The cases of carbon and cost–benefit. Accounting, Organizations and Society, 34(3–4), 499–534.

Lupyan, G., & Clark, A. (2015). Words and the world: Predictive coding and the language-perception-cognition interface. *Current Directions in Psychological Science, 24*(4), 279–284. https://doi.org/10.1177/0963721415570732

Machamer, P., Darden, L., & Craver, C. F. (2000). Thinking about mechanisms. Philosophy of Science, 67(1), 1–25. https://doi.org/10.1086/392759

Mackenzie, E. R., Fegley, S., Stutesman, M., & Mills, J. (2020). Present-moment awareness and the prosocial classroom: Educators' lived experience of mindfulness. Mindfulness, 11(12), 2755–2764. https://doi.org/10.1007/s12671-020-01483-7

Maguire, E. A., Gadian, D. G., et al. (2000). Navigation-related structural change in the hippocampi of taxi drivers. Nature.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. Science, 341(6149), 976–980. https://doi.org/10.1126/science.1238041

Marginson, S. (2016). The worldwide trend to high participation higher education: Dynamics of social stratification in inclusive systems. Higher Education, 72(4), 413–434. https://doi.org/10.1007/s10734-016-0016-x

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224–253. https://doi.org/10.1037/0033-295X.98.2.224

Marx, K. (1976). Capital: Volume I (B. Fowkes, Trans.). Penguin. (Original work published 1867).

Marx, K. (1996). Das Kapital: A critique of political economy (S. Moore & E. Aveling, Trans.). Progress Publishers. (Original work published 1867)

Mashour, G. A., Roelfsema, P., Changeux, J.-P., & Dehaene, S. (2020). Conscious processing and the global neuronal workspace hypothesis. *Neuron, 105*(5), 776–798. https://doi.org/10.1016/j.neuron.2020.01.026

Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4), 370–396. https://doi.org/10.1037/h0054346

Mason, C. (2012). Too good to be true: Private prisons in America. The Sentencing Project.

Masten, A. S., & Cicchetti, D. (2010). Developmental cascades. Development and Psychopathology, 22(3), 491–495. https://doi.org/10.1017/S0954579410000222

May, A. (2011). Experience-dependent structural plasticity in the adult human brain. Trends in Cognitive Sciences, 15(10), 475–482. https://doi.org/10.1016/j.tics.2011.08.002

McAdams, D. P. (2001). The psychology of life stories. *Review of General Psychology, 5*(2), 100–122. https://doi.org/10.1037/1089-2680.5.2.100

McAdams, D. P., & McLean, K. C. (2013). Narrative identity. Current Directions in Psychological Science, 22(3), 233–238. https://doi.org/10.1177/0963721413475622

Meaney, M. J. (2010). Epigenetics and the biological definition of gene × environment interactions. Child Development, 81(1), 41–79. https://doi.org/10.1111/j.1467-8624.2009.01381.x

Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. *Science Advances, 2*(2), e1500323. https://doi.org/10.1126/sciadv.1500323 [CEU Research Pure Portal](https://research.ceu.edu/en/publications/carbon-lock-in-types-causes-and-policy-implications?utm_source=chatgpt.com)

Mellström, C., & Johannesson, M. (2008). Crowding out in blood donation: Was Titmuss right? Journal of the European Economic Association, 6(4), 845–863. https://doi.org/10.1162/JEEA.2008.6.4.845 IDEAS/RePEc

Menary, R. (2013). Cognitive integration, enculturated cognition and the socially extended mind. *Cognitive Systems Research, 25*, 26–34. https://doi.org/10.1016/j.cogsys.2013.05.002

Merritt, A. C., Effron, D. A., & Monin, B. (2010). Moral self-licensing: When being good frees us to be bad. Social and Personality Psychology Compass, 4(5), 344–357. https://doi.org/10.1111/j.1751-9004.2010.00263.x

Merzenich, M. M., Wright, B. A., Jenkins, W., Xerri, C., Byl, N., Miller, S., & Tallal, P. (1996). Cortical plasticity underlying perceptual, motor, and cognitive skill development: Implications for neurorehabilitation. Cold Spring Harbor Symposia on Quantitative Biology, 61, 1–8.

Mesoudi, A. (2011). Cultural evolution: How Darwinian theory can explain human culture and synthesize the social sciences. University of Chicago Press. https://doi.org/10.7208/chicago/9780226520452.001.0001

Metcalf, G. E., & Stock, J. H. (2023). The macroeconomic impact of Europe's carbon taxes. *American Economic Journal: Macroeconomics, 15*(3), 265–286. https://doi.org/10.1257/mac.20210052 [IDEAS/RePEc](https://ideas.repec.org/a/aea/aejmac/v15y2023i3p265-86.html?utm_source=chatgpt.com)

Metzler, H., et al. (2023). Social drivers and algorithmic mechanisms on digital media. Proceedings of the National Academy of Sciences / PMC. https://pmc.ncbi.nlm.nih.gov/articles/PMC11373151/

Miller, A. (1949). Death of a salesman. New York, NY: Viking.

Mirowski, P., & Plehwe, D. (Eds.). (2009). The road from Mont Pèlerin: The making of the neoliberal thought collective. Harvard University Press. CNBC

Moodie, R., Stuckler, D., Monteiro, C., Sheron, N., Neal, B., Thamarangsi, T., … & Casswell, S. (2013). Profits and pandemics: Prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. The Lancet, 381(9867), 670–679. https://doi.org/10.1016/S0140-6736(12)62089-3

Mulder, J. D., & Hamaker, E. L. (2021). Three extensions of the Random Intercept Cross-Lagged Panel Model. Structural Equation Modeling, 28(4), 638–648. https://doi.org/10.1080/10705511.2020.1784738

Muller, J. Z. (2018). The tyranny of metrics. Princeton, NJ: Princeton University Press. (ISBN: 9780691174952). CampusBooks

Murphy, K. M., Shleifer, A., & Vishny, R. W. (1991). The allocation of talent: Implications for growth. Quarterly Journal of Economics, 106(2), 503–530. https://doi.org/10.2307/2937945

Murray, B., & Rivers, N. (2015). British Columbia's revenue-neutral carbon tax: A review of the latest "grand experiment" in environmental policy. *Energy Policy, 86*, 674–683. https://doi.org/10.1016/j.enpol.2015.08.011 [ADS](https://ui.adsabs.harvard.edu/abs/2015EnPol..86..674M/abstract?utm_source=chatgpt.com)

Muthukrishna, M., & Henrich, J. (2016). Innovation in the collective brain. *Philosophical Transactions of the Royal Society B: Biological Sciences, 371*(1690), 20150192. https://doi.org/10.1098/rstb.2015.0192

Muthukrishna, M., & Henrich, J. (2016). Innovation in the collective brain. Philosophical Transactions of the Royal Society B, 371(1690), 20150192. https://doi.org/10.1098/rstb.2015.0192

Nagel, T. (1974). What is it like to be a bat? *The Philosophical Review, 83*(4), 435–450. https://doi.org/10.2307/2183914

New International Version. (2011). Holy Bible, New International Version. Zondervan. (Original work published 1973)

New Zealand Treasury. (2019). The Wellbeing Budget 2019. https://www.treasury.govt.nz/publications/wellbeing-budget/wellbeing-budget-2019

Newell, A., & Rosenbloom, P. S. (1981). Mechanisms of skill acquisition and the law of practice. In J. R. Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 1–55). Lawrence Erlbaum Associates. [No DOI]

Newen, A., De Bruin, L., & Gallagher, S. (Eds.). (2018). The Oxford handbook of 4E cognition. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198735410.001.0001

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. Psychological Review, 108(2), 291–310. https://doi.org/10.1037/0033-295X.108.2.291

Niza, C., Tung, B., & Marteau, T. M. (2013). Incentivizing blood donation: Systematic review and meta-analysis to test Titmuss' hypotheses. Health Psychology, 32(9), 941–949. https://doi.org/10.1037/a0032740 (cited in context via review). Cambridge University Press & Assessment

Norman, D. A. (1988). The psychology of everyday things. Basic Books.

Nussbaum, M. C. (2011). *Creating capabilities: The human development approach*. Harvard University Press. https://doi.org/10.4159/harvard.9780674061200

O'Boyle, E. H., Forsyth, D. R., Banks, G. C., & McDaniel, M. A. (2012). A meta-analysis of the Dark Triad and work behavior: A social exchange perspective. Journal of Applied Psychology, 97(3), 557–579. https://doi.org/10.1037/a0025679 PubMed

O'Neill, B. C., Dalton, M., Fuchs, R., Jiang, L., Pachauri, S., & Zigova, K. (2010). Global demographic trends and future carbon emissions. *Proceedings of the National Academy of Sciences, 107*(41), 17521–17526. [PNAS](https://www.pnas.org/doi/full/?utm_source=chatgpt.com https://doi.org/10.1073/pnas.1004581107?utm_source=chatgpt.com

O'Reilly, C. A., Doerr, B., Caldwell, D. F., & Chatman, J. A. (2014). Narcissistic CEOs and executive compensation. The Leadership Quarterly, 25(2), 218–231. https://doi.org/10.1016/j.leaqua.2013.08.002 Stanford Graduate School of Business

Odling-Smee, F. J., Laland, K. N., & Feldman, M. W. (2003). *Niche construction: The neglected process in evolution*. Princeton University Press. https://doi.org/10.1515/9781400847266

OECD. (2018). Stemming the superbug tide: Just a few dollars more. OECD Publishing. https://doi.org/10.1787/9789264307599-en

OECD. (2022). Promoting health and well-being at work: Policy and practices. https://doi.org/10.1787/e179b2a5-en OECD

OECD. (2023a). Health at a glance 2023: OECD indicators (long-term care workforce). https://doi.org/10.1787/7a7afb35-en

OECD. (2023b). Beyond applause? Improving working conditions in long-term care. https://doi.org/10.1787/27d33ab3-en

Ong, Q., Theseira, W., & Ng, I. Y. H. (2019). Reducing debt improves psychological functioning and changes decision making in the poor. Proceedings of the National Academy of Sciences, 116(15), 7244–7249. https://doi.org/10.1073/pnas.1810901116

Ordóñez, L. D., Schweitzer, M. E., Galinsky, A. D., & Bazerman, M. H. (2009). Goals gone wild: The systematic side effects of overprescribing goal setting. Academy of Management Perspectives, 23(1), 6–16. https://doi.org/10.5465/amp.2009.37007999 Academy of Management Journals

Ostrom, E. (1990). Governing the commons: The evolution of institutions for collective action. Cambridge University Press. https://doi.org/10.1017/CBO9780511807763

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422. https://doi.org/10.1126/science.1172133 ADS

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. Global Environmental Change, 20(4), 550–557. https://doi.org/10.1016/j.gloenvcha.2010.07.004

Ostry, J. D., Loungani, P., & Furceri, D. (2016). Neoliberalism: Oversold? Finance & Development, 53(2), 38–41. (IMF) https://www.imf.org/external/pubs/ft/fandd/2016/06/ostry.htm (No DOI) Cambridge University Press & Assessment

Outterson, K., Rex, J. H., Jinks, T., & Hazel, M. (2016). New business models for sustainable antibiotics. Health Affairs, 35(2), 277–283. https://doi.org/10.1377/hlthaff.2015.1104

Overton, W. F. (2015). Process and relational developmental systems. In W. F. Overton & P. C. M. Molenaar (Eds.), Handbook of child psychology and developmental science: Vol. 1. Theory and method (7th ed., pp. 9–62). Wiley. https://doi.org/10.1002/9781118963418.childpsy102

Oyama, S., Griffiths, P. E., & Gray, R. D. (Eds.). (2001). *Cycles of contingency: Developmental systems and evolution*. MIT Press. https://doi.org/10.7551/mitpress/2310.001.0001

Park, D. C., & Huang, C. M. (2010). Culture wires the brain: A cognitive neuroscience perspective. *Perspectives on Psychological Science, 5*(4), 391–400. https://doi.org/10.1177/1745691610374591

Pascual-Leone, A., Amedi, A., Fregni, F., & Merabet, L. B. (2005). The plastic human brain cortex. Annual Review of Neuroscience, 28, 377–401. https://doi.org/10.1146/annurev.neuro.27.070203.144216

Paulhus, D. L., & Williams, K. M. (2002). The Dark Triad of personality: Narcissism, Machiavellianism, and psychopathy. Journal of Research in Personality, 36(6), 556–563. https://doi.org/10.1016/S0092-6566(02)00505-6

Peirce, C. S. (1931-1958). *Collected papers of Charles Sanders Peirce*. Harvard University Press. [No DOI]

Penney, J. W. (2016). Chilling effects: Online surveillance and Wikipedia use. Berkeley Technology Law Journal, 31(1), 117–182. https://doi.org/10.15779/Z38SS13

Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. Scientific Studies of Reading, 18(1), 22–37. https://doi.org/10.1080/10888438.2013.827687

Petitmengin, C., Remillieux, A., & Valenzuela-Moguillansky, C. (2019). Discovering the structures of lived experience: Toward a micro-phenomenological analysis method. Phenomenology and the Cognitive Sciences, 18(4), 691–730. https://doi.org/10.1007/s11097-018-9597-4

Petrenko, O., Aime, F., Ridge, J., & Hill, A. (2016). Corporate social responsibility or CEO narcissism? CSR motivations and organizational performance. Academy of Management Journal, 59(6), 2625–2647. https://doi.org/10.5465/amj.2014.0069 Harvard Law Forum

Philippon, T. (2015). Has the U.S. finance industry become less efficient? American Economic Review, 105(4), 1408–1438. https://doi.org/10.1257/aer.20120578

Pigou, A. C. (2013). The economics of welfare. Palgrave Macmillan. (Original work published 1920)

Plato. (2007). The Republic (D. Lee, Trans.; 2nd ed.). Penguin. (Original work published ca. 380 BCE)

Plomin, R., DeFries, J. C., Knopik, V. S., & Neiderhiser, J. M. (2016). Top 10 replicated findings from behavioral genetics. *Perspectives on Psychological Science, 11*(1), 3–23. https://doi.org/10.1177/1745691615617432

Polanyi, K. (1944). The great transformation. New York, NY: Farrar & Rinehart.

Pollack, A. (2015, September 20). Drug goes from $13.50 a tablet to $750, overnight. The New York Times. https://www.nytimes.com

Qur’an 9:34–35 (Abdel Haleem, M. A. S., Trans.). (2008). The Qur’an: A new translation. Oxford University Press.

Raichle, M. E., & Gusnard, D. A. (2002). Appraising the brain's energy budget. *Proceedings of the National Academy of Sciences, 99*(16), 10237–10239. https://doi.org/10.1073/pnas.172399499

Ramstead, M. J., Badcock, P. B., & Friston, K. J. (2018). Answering Schrödinger's question: A free-energy formulation. *Physics of Life Reviews, 24*, 1–16. https://doi.org/10.1016/j.plrev.2017.09.001

Ravid, D. M., White, J. C., Tomczak, D. L., Miles, A. F., & Behrend, T. S. (2023). A meta-analysis of the effects of electronic performance monitoring on work outcomes. Personnel Psychology, 76(1), 5–40. https://doi.org/10.1111/peps.12514

Rawls, J. (1999). A theory of justice (Rev. ed.). Harvard University Press. (Original work published 1971)

Raymond, E. L., & Moore, R. (2022). Corporate landlords, institutional investors, and the financialization of rental housing in the United States. Housing Policy Debate, 32(3), 407–423. https://doi.org/10.1080/10511482.2021.2001072

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C., Jr. (2012). Psychology of reading (2nd ed.). Psychology Press. https://doi.org/10.4324/9780203155158

Renfrew, C., & Scarre, C. (Eds.). (1998). Cognition and material culture: The archaeology of symbolic storage. McDonald Institute for Archaeological Research.

Richardson, K., Steffen, W., Rockström, J., et al. (2023). Earth beyond six of nine planetary boundaries. Science Advances, 9(37), eadh2458. https://doi.org/10.1126/sciadv.adh2458

Richardson, T., Elliott, P., & Roberts, R. (2013). The relationship between personal unsecured debt and mental and physical health: A systematic review and meta-analysis. Clinical Psychology Review, 33(8), 1148–1162. https://doi.org/10.1016/j.cpr.2013.08.009

Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed human evolution*. University of Chicago Press. https://doi.org/10.7208/chicago/9780226712130.001.0001

Rietveld, E., & Kiverstein, J. (2014). A rich landscape of affordances. Ecological Psychology, 26(4), 325–352. https://doi.org/10.1080/10407413.2014.958035

Roland, M., & Guthrie, B. (2016). Quality and Outcomes Framework: What have we learnt? BMJ, 354, i4060. https://doi.org/10.1136/bmj.i4060

Rosenthal, D. (2011). Exaggerated reports: Reply to Block. Trends in Cognitive Sciences, 15(12), 566–567. https://doi.org/10.1016/j.tics.2011.10.001

Rosenthal, D. M. (2005). *Consciousness and mind*. Oxford University Press. [No DOI]

Roychowdhury, S. (2006). Earnings management through real activities manipulation. Journal of Accounting and Economics, 42(3), 335–370. https://doi.org/10.1016/j.jacceco.2006.01.002

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Sahdra, B. K., & Shaver, P. R. (2013). Comparing attachment theory and Buddhist psychology. International Journal for the Psychology of Religion, 23(4), 282–293. https://doi.org/10.1080/10508619.2013.795821

Sahdra, B. K., Shaver, P. R., & Brown, K. W. (2010). A scale to measure nonattachment: A Buddhist complement to Western research on attachment and adaptive functioning. Journal of Personality Assessment, 92(2), 116–127. https://doi.org/10.1080/00223890903425960

Sandel, M. J. (2012). What money can't buy: The moral limits of markets. Farrar, Straus and Giroux. Harvard Scholar

Scanlon, T. M. (1998). What we owe to each other. Harvard University Press.

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: The prospective brain. Nature Reviews Neuroscience, 8(9), 657–661. https://doi.org/10.1038/nrn2213

Schechtman, M. (2011). The narrative self. In S. Gallagher (Ed.), *The Oxford handbook of the self* (pp. 394–416). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199548019.013.0017

Scorsese, M. (Director). (2013). The Wolf of Wall Street [Film]. Paramount Pictures.

Scorsese, M. (Director). (2013). The Wolf of Wall Street [Film]. Paramount Pictures.

Scott-Phillips, T. C., Laland, K. N., Shuker, D. M., Dickins, T. E., & West, S. A. (2014). The niche construction perspective: A critical appraisal. Evolution, 68(5), 1231–1243. https://doi.org/10.1111/evo.12332

Searle, J. R. (1997). *The mystery of consciousness*. New York Review Books. [No DOI]

Sen, A. (2009). The idea of justice. Harvard University Press.

Sescousse, G., Caldú, X., Segura, B., & Dreher, J.-C. (2013). Processing of primary and secondary rewards: A quantitative meta-analysis and review of human functional neuroimaging studies. Neuroscience & Biobehavioral Reviews, 37(4), 681–696. https://doi.org/10.1016/j.neubiorev.2013.02.002

Seth, A. K. (2014). A predictive processing theory of sensorimotor contingencies: Explaining the puzzle of perceptual presence and its absence in synesthesia. *Cognitive Neuroscience, 5*(2), 97–118. https://doi.org/10.1080/17588928.2013.877880

Seth, A. K., Barrett, A. B., & Barnett, L. (2015). Granger causality analysis in neuroscience and neuroimaging. Journal of Neuroscience, 35(8), 3293–3297. https://doi.org/10.1523/JNEUROSCI.4399-14.2015

Seto, K. C., Davis, S. J., Mitchell, R. B., Stokes, E. C., Unruh, G., & Ürge-Vorsatz, D. (2016). Carbon lock-in: Types, causes, and policy implications. *Annual Review of

Environment and Resources, 41*, 425–452.
[PNAS](https://www.pnas.org/doi/abs/https://doi.org/10.1073/pnas.142033699?utm_source=chatgpt.com

Shao, C., Ciampaglia, G. L., Varol, O., Yang, K., Flammini, A., & Menczer, F. (2017). The spread of low-credibility content by social bots. Nature Communications, 8, 1–9. https://doi.org/10.1038/s41467-017-01700-8

Shao, C., Ciampaglia, G. L., Varol, O., Yang, K.-C., Flammini, A., & Menczer, F. (2018). The spread of low-credibility content by social bots. Nature Communications, 9, 4787. https://doi.org/10.1038/s41467-018-06930-7

Shonkoff, J. P., & Garner, A. S. (2012). The lifelong effects of early childhood adversity and toxic stress. Pediatrics, 129(1), e232–e246. https://doi.org/10.1542/peds.2011-2662

Signorelli, C. M., & Boils, J. D. (2024). Multilayer networks as embodied consciousness interactions: A formal model approach. Phenomenology and the Cognitive Sciences, 23(5), 1119–1150. https://doi.org/10.1007/s11097-024-09967-w

Simmel, G. (1978). The philosophy of money (T. Bottomore & D. Frisby, Trans.). London: Routledge. (Original work published 1900).

Smillie, I. (2010). Blood on the stone: Greed, corruption and war in the global diamond trade. Anthem Press.

Smith, A. (2002). Effects of caffeine on human behavior. Food and Chemical Toxicology, 40(9), 1243–1255. https://doi.org/10.1016/S0278-6915(02)00096-0

Smith, A. (2012). Wealth of nations. Wordsworth Editions. (Original work published 1776)

Smith, D. R. (1993). Examples on Stress Constitutive Relations. In An Introduction to Continuum Mechanics (pp. 163–176). Springer. https://doi.org/10.1007/978-94-017-0713-8_6

Sorjonen, K., & Melin, B. (2023). Uncertain inference in random-intercept cross-lagged panel models. Personality and Individual Differences, 205, 112083. https://doi.org/10.1016/j.paid.2023.112083

Spar, D. L. (2006). Markets, power, and the global diamond industry. Harvard Business School Case 9-700-017.

Spencer, J. P., Blumberg, M. S., McMurray, B., Robinson, S. R., Samuelson, L. K., & Tomblin, J. B. (2009). Short arms and talking eggs: Why we should no longer abide the nativist-empiricist debate. Child Development Perspectives, 3(2), 79–87. https://doi.org/10.1111/j.1750-8606.2009.00081.x

Squire, L. R., & Dede, A. J. O. (2015). Conscious and unconscious memory systems. Cold Spring Harbor Perspectives in Biology, 7(3), a021667. https://doi.org/10.1101/cshperspect.a021667

Staiger, D. O., Spetz, J., & Phibbs, C. S. (2010). Is there monopsony in the labor market? Evidence from a natural experiment. Journal of Labor Economics, 28(2), 211–236. https://doi.org/10.1086/652734

Standing, G. (2011). The precariat: The new dangerous class. Bloomsbury Academic.

Steger, M. F., Frazier, P., Oishi, S., & Kaler, M. (2006). The meaning in life questionnaire: Assessing the presence of and search for meaning in life. *Journal of Counseling Psychology, 53*(1), 80–93. https://doi.org/10.1037/0022-0167.53.1.80

Sterelny, K. (2012). *The evolved apprentice: How evolution made humans unique*. MIT Press. https://doi.org/10.7551/mitpress/9209.001.0001

Sterling, P., & Laughlin, S. (2015). Principles of neural design. MIT Press. https://doi.org/10.7551/mitpress/9780262028707.001.0001

Stern, N. (2007). The economics of climate change: The Stern Review. Cambridge University Press. https://doi.org/10.1017/CBO9780511817434

Steward, D. R., Allen, A. J., et al. (2013). Tapping unsustainable groundwater stores for agricultural production in the High Plains Aquifer of Kansas. Proceedings of the National Academy of Sciences, 110(37), E3477–E3486. https://doi.org/10.1073/pnas.1220351110

Stokes, P. A., & Purdon, P. L. (2017). A study of problems encountered in Granger causality analysis from a neuroscience perspective. Proceedings of the National Academy of Sciences, 114(34), E7063–E7072. https://doi.org/10.1073/pnas.1704663114

Stout, L. A. (2011). Derivatives and the legal origin of the 2008 credit crisis. Harvard Business Law Review, 1(1), 1–38.

Strathern, M. (1997). ‘Improving ratings’: Audit in the British university system. European Review, 5(3), 305–321. https://doi.org/10.1002/(SICI)1234-981X(199707)5:3<305::AID-EURO184>3.0.CO;2-4 Cambridge University Press & Assessment

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences, 30*(3), 299–313. https://doi.org/10.1017/S0140525X07001975

Suddendorf, T., Addis, D. R., & Corballis, M. C. (2009). Mental time travel and the shaping of the human mind. Philosophical Transactions of the Royal Society B, 364(1521), 1317–1324. https://doi.org/10.1098/rstb.2008.0301

Sullivan, S. (2017). On ‘natural capital’, ‘fairy tales’ and ideology. Development and Change, 48(2), 397–423. https://doi.org/10.1111/dech.12292

Sun, H. (2024). The right to know social media algorithms. Harvard Law & Policy Review, 18(1), 1–35. https://journals.law.harvard.edu/lpr/wp-content/uploads/sites/89/2024/08/18.1-Right-to-Know-Social-Media-Algorithms.pdf

Swinburn, B. A., Kraak, V. I., Allender, S., Atkins, V. J., Baker, P. I., Bogard, J. R., … & Dietz, W. H. (2019). The global syndemic of obesity, undernutrition, and climate change:

The Lancet Commission report. The Lancet, 393(10173), 791–846. https://doi.org/10.1016/S0140-6736(18)32822-8

Sys, S., Van Gordon, W., & Gilbert, P. (2024). A qualitative comparison of secular and Buddhist-informed mental health practitioners' perceptions of non-attachment. Mindfulness, 15(2), 345–358. https://doi.org/10.1007/s12671-023-02291-5

Tang, K., & Xiong, W. (2012). Index investment and the financialization of commodities. Financial Analysts Journal, 68(6), 54–74. https://doi.org/10.2469/faj.v68.n6.5

Tang, Y.-Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. Nature Reviews Neuroscience, 16(4), 213–225. https://doi.org/10.1038/nrn3916

Tang, Y.-Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., Yu, Q., Sui, D., Rothbart, M. K., Fan, M., & Posner, M. I. (2007). Short-term meditation training improves attention and self-regulation. Proceedings of the National Academy of Sciences of the United States of America, 104(43), 17152–17156. https://doi.org/10.1073/pnas.0707678104

Tay, L., & Diener, E. (2011). Needs and subjective well-being around the world. Journal of Personality and Social Psychology, 101(2), 354–365. https://doi.org/10.1037/a0023779

Tenenbaum, J. B., Kemp, C., Griffiths, T. L., & Goodman, N. D. (2011). How to grow a mind: Statistics, structure, and abstraction. *Science, 331*(6022), 1279–1285. https://doi.org/10.1126/science.1192788

Thelen, E., & Smith, L. B. (1994). A dynamic systems approach to the development of cognition and action. MIT Press.

Thomson, R., Yuki, M., Talhelm, T., Schug, J., Kito, M., Ayanian, A. H., & Visserman, M. L. (2018). Relational mobility predicts social behaviors in 39 countries and is tied to historical farming and pathogen prevalence. Proceedings of the National Academy of Sciences, 115(48), 11983–11988. https://doi.org/10.1073/pnas.1811621115

Tikkanen, R., & Abrams, M. K. (2020). U.S. health care from a global perspective, 2019: Higher spending, worse outcomes? Commonwealth Fund. https://doi.org/10.26099/7avy-jc84

Tobi, E. W., Lumey, L. H., Talens, R. P., Kremer, D., Putter, H., Stein, A. D., Slagboom, P. E., & Heijmans, B. T. (2009). DNA methylation differences after exposure to prenatal famine are common and timing- and sex-specific. Human Molecular Genetics, 18(21), 4046–4053. https://doi.org/10.1093/hmg/ddp353

Tomasello, M. (1999). *The cultural origins of human cognition*. Harvard University Press. https://doi.org/10.2307/j.ctvjsf4jc

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. Behavioral and Brain Sciences, 28(5), 675–691. https://doi.org/10.1017/S0140525X05000129

Tononi, G., Boly, M., Massimini, M., & Koch, C. (2016). Integrated information theory: from consciousness to its physical substrate. *Nature Reviews Neuroscience, 17*(7), 450–461. https://doi.org/10.1038/nrn.2016.44

Tucker-Drob, E. M., & Briley, D. A. (2014). Continuity of genetic and environmental influences on cognition across the life span: A meta-analysis of longitudinal twin and adoption studies. Psychological Bulletin, 140(4), 949–979. https://doi.org/10.1037/a0035893

Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology, 53*(1), 1–25. https://doi.org/10.1146/annurev.psych.53.100901.135114

Turkheimer, E. (2000). Three laws of behavior genetics and what they mean. *Current Directions in Psychological Science, 9*(5), 160–164. https://doi.org/10.1111/1467-8721.00084

U.S. Commodity Futures Trading Commission, & U.S. Securities and Exchange Commission. (2010). Findings regarding the market events of May 6, 2010: Report of the staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues. https://www.sec.gov/news/studies/2010/marketevents-report.pdf

U.S. Securities and Exchange Commission. (2010a). SEC charges Goldman Sachs with fraud in structuring and marketing of CDO tied to subprime mortgages (Litigation Release No. 21489). https://www.sec.gov/enforcement-litigation/litigation-releases/lr-21489

U.S. Securities and Exchange Commission. (2020). In the matter of Robinhood Financial, LLC: Order instituting administrative and cease-and-desist proceedings (Release No. 10906). https://www.sec.gov/files/litigation/admin/2020/33-10906.pdf

U.S. Securities and Exchange Commission. (2022). SEC v. Archegos Capital Management, LP, et al.: Complaint. https://www.sec.gov/files/litigation/complaints/2022/comp-pr2022-70.pdf

Underwood, F. M., Burn, R. W., & Milliken, T. (2013). Dissecting the illegal ivory trade: An analysis of ivory seizures data. PLoS ONE, 8(10), e76539. https://doi.org/10.1371/journal.pone.0076539

Unruh, G. C. (2000). Understanding carbon lock-in. *Energy Policy, 28*(12), 817–830. https://doi.org/10.1016/S0301-4215(00)00070-7

Vaki, F. (2024). Neoliberalism, democracy, and rights: Towards a critique of neoliberal reason. Springer. https://doi.org/10.1007/978-3-031-61467-5 SpringerLink

Van Zee, A. (2009). The promotion and marketing of OxyContin: Commercial triumph, public health tragedy. American Journal of Public Health, 99(2), 221–227. https://doi.org/10.2105/AJPH.2007.131714

Varela, F. J. (1999). *Ethical know-how: Action, wisdom, and cognition*. Stanford University Press. https://doi.org/10.1515/9781503617463

Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. MIT Press. https://doi.org/10.7551/mitpress/6730.001.0001

Vohs, K. D., Mead, N. L., & Goode, M. R. (2006). The psychological consequences of money. Science, 314(5802), 1154–1156. https://doi.org/10.1126/science.1132491

Wackernagel, M., Schulz, N. B., Deumling, D., Linares, A. C., Jenkins, M., Kapos, V., … Randers, J. (2002). Tracking the ecological overshoot of the human economy. *Proceedings of the National Academy of Sciences, 99*(14), 9266–9271. [Annual Reviews](https://www.annualreviews.org/content/journals/https://doi.org/10.1146/annurev-environ-110615-085934?utm_source=chatgpt.com

Wahba, M. A., & Bridwell, L. G. (1976). Maslow reconsidered: A review of research on the need hierarchy theory. Organizational Behavior and Human Performance, 15(2), 212–240. https://doi.org/10.1016/0030-5073(76)90038-6

Wei, H., Li, J., & Sun, X. (2022). How algorithms make the workplace: A qualitative analysis of Chinese couriers. medRxiv. https://doi.org/10.1101/2022.09.13.22279887

Weidinger, L., et al. (2021). Ethical and social risks of harm from language models. arXiv preprint arXiv:2112.04359. https://arxiv.org/abs/2112.04359

Wenger, E., Brozzoli, C., Lindenberger, U., & Lövdén, M. (2017). Expansion and renormalization of human brain structure during skill acquisition. *Trends in Cognitive Sciences, 21*(12), 930–939. https://doi.org/10.1016/j.tics.2017.09.008

Werker, J. F., & Hensch, T. K. (2015). Critical periods in speech perception: new directions. *Annual Review of Psychology, 66*, 173–196. https://doi.org/10.1146/annurev-psych-010814-015104

WHO (World Health Organization). (2025). Health workforce: Key figures. https://www.who.int/teams/health-workforce

WHO. (2020). Antibacterial pipeline: 2020. World Health Organization. https://www.who.int/publications/i/item/9789240021303

Wiedmann, T. O., Schandl, H., et al. (2015). The material footprint of nations. Proceedings of the National Academy of Sciences, 112(20), 6271–6276. https://doi.org/10.1073/pnas.1220362110

Wiedmann, T., Lenzen, M., Keyßer, L. T., & Steinberger, J. K. (2020). Scientists' warning on affluence. *Nature Communications, 11*, 3107. https://doi.org/10.1038/s41467-020-16941-y [NBER](https://www.nber.org/papers/w27488?utm_source=chatgpt.com)

Wieseler, B., McGauran, N., Kaiser, T., & Richter, T. (2019). New drugs: Where did we go wrong and what can we do better? BMJ, 366, l4340. https://doi.org/10.1136/bmj.l4340

Wilson, E. O. (1978). *On human nature*. Harvard University Press. [No DOI]

Withagen, R., de Poel, H. J., Araújo, D., & Pepping, G.-J. (2012). Affordances can invite behavior: Reconsidering the relationship between affordances and agency. New Ideas in Psychology, 30(2), 250–258. https://doi.org/10.1016/j.newideapsych.2011.12.003

Witherington, D. C. (2007). The dynamic systems approach as metatheory for developmental psychology. Human Development, 50(2-3), 127–153. https://doi.org/10.1159/000100943

Woodward, J. (2003). *Making things happen: A theory of causal explanation*. Oxford University Press. https://doi.org/10.1093/0195155270.001.0001

Yokum, D., Ravishankar, A., & Coppock, A. (2019). A randomized control trial evaluating the effects of police body-worn cameras. Proceedings of the National Academy of Sciences, 116(21), 10329–10332. https://doi.org/10.1073/pnas.1814773116

Zahavi, D. (2005). *Subjectivity and selfhood: Investigating the first-person perspective*. MIT Press. https://doi.org/10.7551/mitpress/6541.001.0001

Zelizer, V. A. (1994). The social meaning of money. New York, NY: Basic Books.

Zhang, T.-Y., & Meaney, M. J. (2010). Epigenetics and the environmental regulation of the genome and its function. Annual Review of Psychology, 61, 439–466. https://doi.org/10.1146/annurev.psych.60.110707.163625

Zuboff, S. (2019). The age of surveillance capitalism: The fight for a human future at the new frontier of power. PublicAffairs.