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Proposed Mechanisms of Existential Resilience: A Heuristic Framework Integrating Free Energy Principle, Affective Criticality and Spatiotemporal Neuroscience

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Abstract

Background: Contemporary psychiatry has achieved unprecedented neurobiological precision in understanding symptom-level mechanisms, yet clinical outcomes remain stagnant—depression prevalence unchanged, suicide rates rising, and patients frequently reporting existential emptiness despite achieving symptom remission. This paradox suggests a fundamental theoretical gap: psychiatry lacks a scientific language for meaning. Objective: This paper develops the Neuro-Existential Architecture System (NEAS), integrating five previously disparate theoretical domains—Friston's Free Energy Principle, Melloni's laminar cortical architecture, Tucker's affective criticality, Northoff's spatiotemporal neuroscience, and Frankl's existential psychology—into a unified framework explaining how meaning stabilizes resilience at the neurobiological level. Theoretical Framework: The NEAS proposes that meaning is the highest-order generative model in the brain's hierarchical predictive system. It is not epiphenomenal but thermodynamically necessary: meaning minimizes free energy by providing a stable prior that constrains lower hierarchical levels through downward causation. Three core mechanisms are proposed: (1) Model Shattering and Reconstruction—how trauma destabilizes priors and meaning-centered recovery provides scaffolding for reintegration; (2) Affective Criticality—how meaning maintains the balance between confidence and error-checking that characterizes optimal neural function; (3) Spatiotemporal Coherence—how meaning extends temporal integration windows, preventing dissociation and fragmentation. Clinical and Empirical Implications: The framework generates a three-level intervention model (physiological, narrative, existential) and four falsifiable predictions regarding autocorrelation window extension, infra-slow oscillation strengthening, laminar disruption in trauma, and three-level intervention efficacy. Conclusions: By grounding existential meaning in neurobiological architecture, the NEAS bridges a century-long gap between neuroscience and existential psychology, explaining why meaning is fundamental to resilience and suggesting that psychiatry must become a science of meaning to advance beyond symptom management toward genuine healing.

Keywords: meaning and purpose; hierarchical predictive processing; resilience and trauma recovery; affective criticality; spatiotemporal coherence; memory reconsolidation; existential neuroscience neural architecture (NEAS)

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Section 1: Toward a Neuro-Existential Architecture System

1. Meaning, Resilience, and the Integration of Five Theoretical Domains

1.1. The Precision-Despair Paradox: A Conceptual Crisis in Contemporary Psychiatry

Contemporary psychiatry finds itself confronted with a striking empirical observation. Over the past two decades, neuroscientific methods and technologies have advanced to unprecedented levels of sophistication. High-field functional neuroimaging, molecular genetics, and computational modeling have enabled researchers to characterize the brain's architecture with extraordinary precision (Friston, 2010; Northoff, 2018). We can now map neural circuits with millimeter accuracy, identify genetic risk factors with increasing specificity, and simulate neural dynamics through sophisticated mathematical models. By any conventional measure of scientific progress—methodological sophistication, technical precision, explanatory scope—neuroscience is advancing rapidly.

Yet the clinical reality tells a different story. Global prevalence rates for major depressive disorder, anxiety disorders, and other conditions characterized by existential distress remain unchanged or continue to rise despite these neurobiological advances. Suicide rates, far from declining as one might expect from improved psychiatric treatment, have increased in many developed nations. In the United States, suicide rates have risen by approximately 30% over the past twenty years (Turecki & Brent, 2016). Treatment response rates to psychopharmacological interventions have not substantially improved over three decades. Perhaps most revealing: individuals who achieve symptomatic remission through medication and evidence-based psychotherapy frequently report an enduring sense of meaninglessness—a hollowness that persists despite the technical absence of diagnosable symptoms.

This empirical gap—that neurobiological precision has not translated into clinical efficacy—suggests something more fundamental than a temporary setback in research progress. It suggests a conceptual gap rather than a methodological one. The gap is not one of insufficient data or inadequate methods. Current psychiatric frameworks, rooted primarily in a biomedical model, have successfully characterized the mechanisms of symptom-level phenomena. Yet these same frameworks remain largely silent on a question that preceded neuroscience by millennia: What makes human existence meaningful? And how does the absence of meaning destabilize the very biological systems that psychiatry treats? To ground the NEAS within contemporary psychological discourse, it is necessary to align its neurobiological framework with the established tripartite definition of meaning in life. In psychological literature, meaning is typically conceptualized through three distinct but interrelated facets: coherence (the cognitive sense that life is predictable and makes sense), purpose (the motivational component of having valued goals and direction), and significance (the existential realization that one's life possesses inherent value and 'matters') (Martela & Steger, 2016).

The NEAS proposes that these psychological facets are not merely subjective states but the phenomenological correlates of a high-level generative model. Specifically, coherence reflects the model's ability to minimize prediction error; purpose represents the goal-directed priors that constrain action; and significance emerges from the thermodynamic stability of the overall hierarchical architecture.

This is not a criticism of modern neuroscience or of contemporary psychiatry. Rather, it is an observation that these disciplines have achieved remarkable specificity in explaining symptom-level phenomena while remaining agnostic about the hierarchical organization that coordinates these systems in service of a coherent sense of purpose. As a result, psychiatry treats the individual notes of suffering without understanding the symphony through which those notes might gain coherence and meaning.

1.2. Why Current Psychiatry Cannot Address Meaning: The Integration Gap

The existential psychology tradition, spanning from Søren Kierkegaard through Viktor Frankl to Irvin Yalom, has consistently documented a fundamental insight: the human being is, fundamentally, a creature in search of meaning (Frankl, 1946/1992; May, 1953; Yalom, 2008). This is not a peripheral or optional observation. Rather, existential psychologists have argued that the search for meaning is the primary psychological motivation—more fundamental than drives for safety, pleasure, or social belonging. Frankl's observations are particularly striking. During his imprisonment in concentration camps, he made a remarkable clinical observation: survival was not predicted by health, strength, or access to resources. Instead, survival was predicted by meaning. Individuals who maintained a sense of existential purpose survived trauma that killed those without such a framework, regardless of differences in physical condition or circumstantial advantage.

Yet when contemporary psychiatry encounters existential suffering—what Frankl termed the existential vacuum—the field lacks a coherent scientific language to describe it. A patient presents with depressed mood, anhedonia, and diminished interest in activities. These symptoms are coded according to diagnostic criteria as Major Depressive Disorder. Treatment proceeds via monoamine augmentation or psychotherapy. If the patient responds, symptom checklist scores improve. But what if the patient reports: "My depression has lifted, my mood is stable, yet my life feels empty and purposeless"? Current psychiatry translates this into "treatment-resistant residual symptoms" or "persistent depressive symptoms." The underlying architectural problem—the collapse of existential coherence—becomes invisible to the diagnostic framework.

This is not a failure of psychiatric methodology per se. It is, rather, a failure of integration. Neuroscience and existential psychology have developed in largely separate intellectual ecosystems. Neuroscience speaks the language of molecular cascades, synaptic weights, and neural oscillations (Friston, 2010). Existential psychology speaks the language of authenticity, meaning-making, and the human condition. The two have maintained cordial distance, with neuroscience regarding existential concerns as epiphenomenal and existential psychology regarding neuroscience as reductionist.

Yet converging evidence suggests both perspectives are addressing the same phenomenon from different vantage points. An individual experiencing existential emptiness shows measurable changes in brain function. A person who reconstructs meaning following trauma shows neurobiological changes in brain organization. The brain is not causing the existential experience, nor is the existential experience somehow free-floating above neurobiology. They are different perspectives on a unified phenomenon. What is needed is a theoretical framework that can translate between these languages—one that shows how existential meaning maps onto neurobiological architecture.

1.3. Five Scattered Literatures That Hold the Answer

Remarkably, the intellectual resources needed to bridge this gap already exist in contemporary science. They are simply dispersed across five distinct research domains, each addressing a different facet of the integration problem, but rarely in conversation with one another.

1.3.1. Friston's Free Energy Principle: The Mathematics of Hierarchical Organization

Karl Friston's Free Energy Principle provides a mathematical framework for understanding how biological systems maintain organization (Friston, 2010). The core insight is that living systems remain organized by maintaining accurate generative models of their environment. Crucially, Friston's framework is fundamentally hierarchical. Higher-level predictions stabilize lower-level ones through a process called hierarchical precision-weighting. A violation of high-level expectations cascades downward through the system, destabilizing lower levels. The Free Energy Principle predicts that biological systems must maintain stable models at all hierarchical levels, including the most abstract level. Yet Friston's principle remains agnostic about the content of these highest-level priors—it tells us that the system needs them, but not what they are.

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1.3.2. Melloni's Laminar Architecture: Neuroanatomical Specificity

Lucia Melloni and colleagues have provided neuroanatomical specificity by mapping where, in the brain's six-layered cortical structure, predictions and prediction errors are generated (Bastos et al., 2012; Melloni et al., 2007). Using high-field neuroimaging, they have demonstrated that feedforward projections carry predictions downward from higher to lower cortical areas, while feedback projections carry error signals upward. Deep cortical layers maintain the generative models that generate these predictions. This laminar specificity tells us where hierarchical prediction happens neurobiologically. Yet the laminar architecture literature has been less explicit about how these hierarchical mechanisms are regulated when predictions fail catastrophically.

1.3.3. Tucker and Luu's Affective Criticality: The Regulation Problem

Don Tucker and Phan Luu's theory of affective criticality addresses the regulation problem directly (Tucker & Luu, 2021; Tucker, Luu, & Friston, 2025). They propose that emotion is not a secondary system overlaid on cognition, but rather the primary regulatory mechanism of hierarchical prediction itself. Two complementary limbic systems—the dorsal system associated with excitement and forward drive, and the ventral system associated with anxiety and error-checking—regulate the relative precision given to predictions versus error signals. For optimal cognitive function, these two systems must be in dynamic balance—what Tucker calls "criticality." This framework provides a mechanism for understanding how emotion regulates the hierarchical system. Yet it does not explicitly address: What role does meaning play in maintaining this affective balance?

1.3.4. Northoff's Spatiotemporal Neuroscience: The Unified Substrate

Georg Northoff proposes that time and space are not merely categories through which the brain perceives reality, but the fundamental substrate through which the brain organizes itself (Northoff, 2018; Northoff & Huang, 2017). Consciousness arises not from particular brain regions, but from the brain's spatiotemporal structure. Recent advances in measuring the brain's slow oscillations and temporal correlations provide a tool for measuring the temporal coherence of consciousness itself. Yet Northoff's work has engaged less with the existential question: How does existential meaning relate to spatiotemporal coherence?

1.3.5. Frankl's Existential Psychology: The Necessity of Meaning

Finally, Viktor Frankl's existential psychology provides the existential grounding that the neuroscientific frameworks lack (Frankl, 1946/1992). From his clinical work and his survival of Nazi concentration camps, Frankl documented that meaning is a necessity for human psychological survival. Individuals who maintained a sense of existential purpose survived trauma that killed others. Frankl introduced the concept of the "noetic dimension"—the realm of meaning, values, and purpose that lifts humans above their biological and psychological drives. Healing is about reconnection with meaning—what Frankl termed logotherapy, healing through logos, or meaning. Yet Frankl's work has struggled to achieve integration with contemporary neuroscience.

Table 1. Integration of Five Theoretical Frameworks into the Neuro-Existential Architecture System (NEAS).

Framework & Proponent	**Primary Focus**	**Key Mechanism(s)**	**Implementation Level**	**Theoretical Contribution to Architecture**
Free Energy Principle (Friston)	Thermodynamic necessity for biological self-organization.	Prediction error minimization through active inference.	Theoretical / Mathematical Modeling	Establishes *why* stable, high-level priors are metabolically necessary to resist entropy.

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Laminar Cortical Architecture (Melloni)	Neuroanatomical basis of predictive hierarchy.	Layer-specific feedforward (prediction error) and feedback (prediction) signaling.	Anatomical / Circuit Level	Describes *how* hierarchical predictive processing is physically implemented in the cortex.
Affective Criticality (Tucker)	Dynamic regulation of cognitive and neural precision.	Dual limbic systems regulating Excitation/Inhibition (E/I) balance.	Neuromodulatory Level	Explains *how* emotion maintains optimal flexibility (criticality) and dictates the gain on prediction errors.
Spatiotemporal Neuroscience (Northoff)	Temporal-spatial coherence as the basis of consciousness.	Infra-slow oscillations establishing intrinsic autocorrelation windows.	Temporal Dynamics	Demonstrates *how* stable consciousness depends on spatiotemporal integration across scales.
Existential Psychology (Frankl)	The existential necessity of meaning for survival.	"Will to meaning" acting as the highest-order generative model.	Phenomenological / Existential Level	Proposes that meaning acts as a thermodynamic necessity for survival at the experiential level.

Each framework addresses a different level of biological organization and different scientific questions—from mathematical thermodynamics to existential philosophy—yet all converge on the principle that meaning is the highest-order organizing architecture through which resilience emerges.

1.4. The Synthesis: Why These Five Literatures Must Be Integrated

Viewed separately, each framework captures important truths but remains incomplete. Yet when integrated, they reveal something none could show alone.

Friston's Free Energy Principle tells us that hierarchical systems require stable, high-level priors. Melloni's laminar architecture shows us where these are implemented in cortical structure. Tucker's affective criticality explains how they are regulated dynamically. Northoff's spatiotemporal framework tells us that this hierarchical organization unfolds through time and across space. And Frankl's existential psychology tells us what these highest-level priors are: they are meaning structures.

When integrated, these five frameworks reveal a central insight: Meaning is not a luxury or a philosophical abstraction. Meaning is the highest-order stabilizing structure of the human brain's hierarchical organization. When meaning is present and stable, it stabilizes the entire system—from the regulation of neurotransmitters at the lowest level, through autobiographical narrative coherence at the intermediate level, to existential authenticity at the highest level. When meaning collapses, the entire hierarchy destabilizes in cascade.

This is why individuals with strong meaning survive trauma that kills those without it. Not because they have thicker prefrontal cortices or more favorable genetic factors, but because meaning provides a stable framework that allows the system to integrate aversive experiences without fundamental collapse. Meaning literally holds the architecture together. Conversely, this is why standard psychiatric treatments—focused on symptoms and neurotransmitters—often fail to produce lasting improvement in wellbeing, even when they successfully reduce symptom severity. They treat the lower levels of the hierarchy without addressing its organizing principle.

1.5. The Neuro-Existential Architecture System: Overview and Scope

Building upon preliminary NEAS conceptualization previously disseminated as a preprint (Leidig, 2025), the present article substantially expands this framework through integration of five major theoretical domains, specification of three core mechanisms, development of a three-level intervention model, and derivation of four falsifiable empirical predictions.

Model Shattering and Reconstruction: How traumatic events can destabilize the brain's predictive models across hierarchical levels, and why meaning-centered recovery requires the scaffolding of higher-level existential priors.

Affective Criticality: How meaning maintains the delicate balance between excessive confidence in internal models and excessive sensitivity to errors, keeping the system at optimal criticality.

Spatiotemporal Coherence: How meaning extends the brain's temporal integration window, allowing fleeting moments of suffering to be embedded in larger narratives of purpose and continuity.

The NEAS framework generates multiple empirically testable predictions. Importantly, this is presented as a theoretical model intended to guide future research, not as an empirical finding or validated clinical intervention. No new experimental data are presented. Rather, we propose a conceptual synthesis intended to reframe how psychiatry understands the relationship between meaning, brain function, and resilience.

The paper proceeds as follows. Section 2 develops the five theoretical foundations in comprehensive detail, showing how their limitations motivate integration. Section 3 presents the NEAS model itself, detailing the mechanisms through which meaning stabilizes the system. Section 4 discusses clinical and empirical implications, outlining testable predictions. Finally, Section 5 discusses limitations and future research directions.

The central claim we defend is this: If psychiatry is to advance beyond symptom management toward genuine healing, it must develop a coherent scientific language for meaning. The NEAS proposes such a language—one grounded in contemporary neuroscience yet respectful of the existential insights that psychiatry's biomedical model has necessarily obscured.

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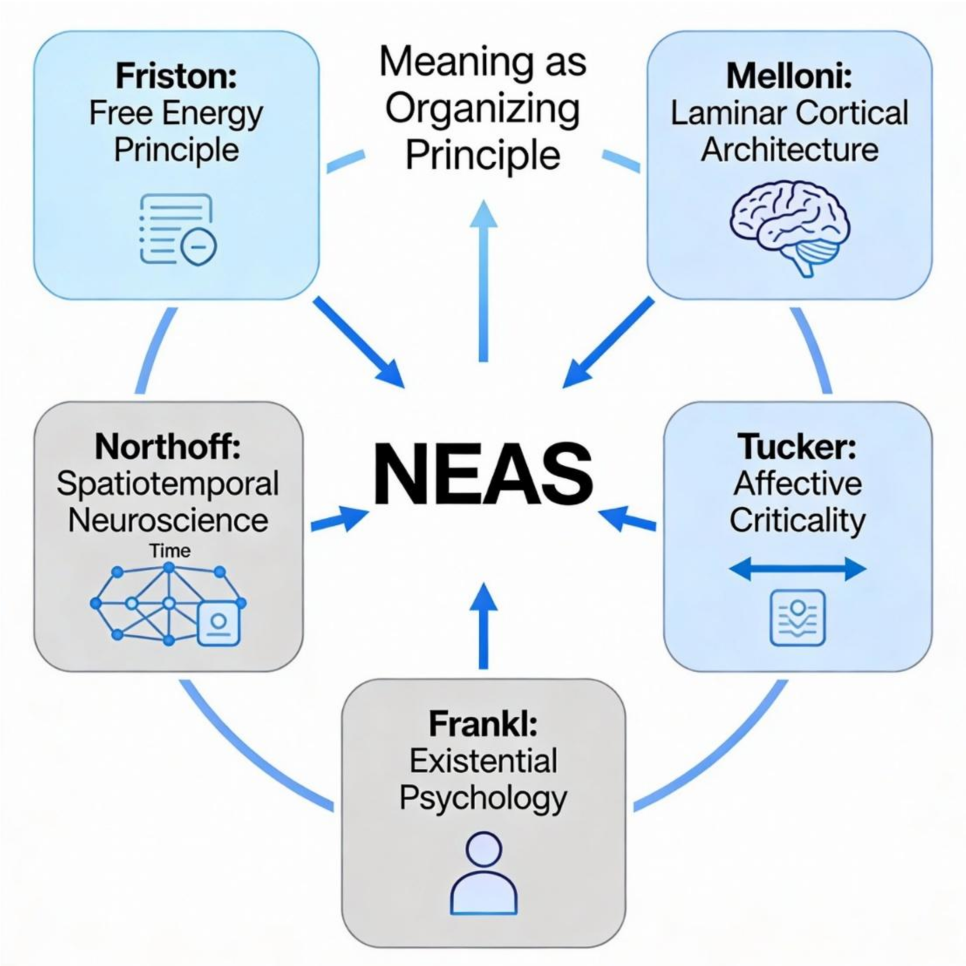

Figure 1. Five-Framework Integration into the Neuro-Existential Architecture System.

The NEAS synthesizes Friston's Free Energy Principle (mathematical foundation), Melloni's laminar cortical architecture (neuroanatomical implementation), Tucker's affective criticality (dynamic regulation), Northoff's spatiotemporal neuroscience (temporal-spatial coherence), and Frankl's existential psychology (meaning necessity) into a unified model explaining how meaning stabilizes hierarchical neural organization.

Section 2: Theoretical Foundations & the Neas Model

2. Developing the Five Frameworks and Their Integration

2.1. Hierarchical Predictive Processing: The Architecture of the Brain as a Generative System

The conventional neuroscientific view positions the brain as a sensor and processor of sensory inputs. Information arrives at the sensory organs, is transmitted to the brain, processed through successive stages, and finally generates a behavioral response. This model, while intuitive, has been fundamentally challenged by contemporary predictive processing theories. The brain, according to this alternative perspective, is not primarily a reactive sensor but a generative system—a constantly active model-builder that anticipates what will happen next (Friston, 2010). At each moment, the brain allocates approximately 80% of its computational resources to generating predictions about the immediate future, and only about 20% to comparing these predictions against incoming sensory reality. This allocation is not arbitrary. It reflects a fundamental principle of thermodynamic efficiency: generating predictions is metabolically cheap; processing surprising inputs is metabolically expensive.

The mechanism underlying this predictive function is what neuroscientists term the "prior"—what the system expects before receiving new information. A prior is not a conscious belief or assumption. Rather, it is a statistical expectation about the world, implemented through the sustained patterns of neural activity in generative models. Consider a simple example: You expect your morning coffee to be hot. If it is cold, you experience this as a "prediction error"—a surprise that requires explanation and learning. The brain is constantly generating such expectations across multiple timescales and hierarchical levels. These priors constrain what we perceive, what we attend to, and ultimately, how we interpret the world.

The Free Energy Principle, developed by Karl Friston, provides the mathematical formalization of this process (Friston, 2010). In thermodynamic terms, "free energy" captures the trade-off between two competing demands: maintaining simple, stable models (low complexity) while accurately fitting observed data (high accuracy). Mathematically expressed as F = Complexity − Accuracy, the Free Energy Principle states that biological systems minimize free energy by maintaining accurate priors that are neither so rigid that they fail to fit new data, nor so flexible that they become unstable and computationally expensive. This is not merely a metaphor; it is a testable, mathematically formalized principle grounded in statistical physics.

Crucially, the brain does not implement prediction at a single hierarchical level. Instead, it maintains what Friston termed a "hierarchical generative model"—a stack of nested predictions, from the lowest sensory level to progressively higher levels of abstraction. At the lowest level, the system generates predictions about immediate sensory input: "What will I see or feel in the next 100 milliseconds?" At intermediate levels, it generates predictions about narrative and identity: "What is my life story? Who am I?" At the highest level, it generates existential predictions: "What is my life for? What makes my existence coherent?" Each level in this hierarchy generates predictions about the level below it. Each level simultaneously receives error signals from below when its predictions fail. Critically, higher levels stabilize lower levels through a process called "downward causation"—when your high-level belief about who you are (identity prior) is stable, it constrains and stabilizes the narratives and interpretations that unfold at lower levels. Conversely, when the highest-level prior collapses—when meaning is lost—the entire hierarchy destabilizes in cascade.

This hierarchical organization solves a fundamental problem: single-level prediction is unstable. Every new data point that contradicts the model demands complete recomputation. But when predictions are organized hierarchically, higher levels can constrain lower-level flexibility, allowing the system to handle new information without perpetual destabilization. A ship's navigation provides the metaphor: the high-level goal (reach the harbor) constrains the helmsman's moment-to-moment adjustments (correct for current). Without that high-level goal, every gust of wind would require reimagining the entire voyage. Without stable meaning (the high-level prior), every negative experience destabilizes the entire self-model.

2.2. Laminar Implementation: Where Hierarchical Prediction Happens in Cortical Circuitry

The theoretical elegance of hierarchical predictive processing gains concrete neurobiological grounding through advances in mapping the laminar organization of the neocortex. The cortex is organized into six distinct layers, each with characteristic cell types and connectivity patterns. Lucia Melloni and colleagues have provided empirical specification of how this laminar architecture implements hierarchical prediction (Bastos et al., 2012; Melloni et al., 2007). Using high-field neuroimaging and electrophysiology, they have demonstrated that feedforward and feedback signaling utilize distinct laminar pathways, each carrying different types of information through the hierarchical system.

Feedforward projections—those carrying predictions from higher to lower cortical areas—originate from superficial layers (particularly layers II and III) of higher cortical regions and project directly to the deep layers (V and VI) of lower cortical areas, bypassing layer IV (the canonical input layer) of the target area. These projections are excitatory, mediated by glutamate, and carry the message: "I predict you will receive this input." They function to bias lower-level processing before sensory input arrives, a computational strategy that improves efficiency by constraining the space of possible interpretations. The remarkable aspect is that these predictions arrive at lower cortical areas before the actual sensory input. This is not a flaw in timing but a core feature: the system is so confident in its predictions that it pre-processes them, ensuring that when sensory input arrives, it is already contextualized by higher-level expectations.

Feedback projections—those carrying error signals from lower to higher cortical areas—follow a complementary anatomical pathway. They originate from the deep layers (V and VI) of lower cortical areas, pass through the thalamus (which acts as a relay and gating mechanism), and arrive back at layer IV and the superficial layers of higher cortical areas. These feedback connections are inhibitory (often mediated through interneurons and modulatory systems) and carry the message: "Your prediction was wrong. Here is what I actually observed." The inhibitory nature of feedback signals is functionally significant: when predictions are accurate, feedback inhibition is minimal, and the system proceeds smoothly. When predictions fail dramatically, strong inhibitory feedback signals propagate upward, signaling that the current model is inadequate and requires updating.

The balance between feedforward (prediction) and feedback (error) signaling is essential for healthy cortical function. When they are well-balanced, the system can flexibly update representations as new data arrives. But when this balance collapses—particularly when the ability to gate or modulate error signals breaks down—the system becomes vulnerable to catastrophic destabilization. This is where stress physiology becomes neurobiologically relevant. Under acute threat, the sympathetic nervous system releases stress hormones, including cortisol and adrenaline. These hormones have specific effects on the neurons in deep cortical layers that would normally gate error signals. Research in animal models has shown that high stress hormone concentrations can cause the retraction of apical dendrites (the parts of neurons that receive feedback signals) in layer V pyramidal cells. When this happens, the normal gating capacity of deep layers is compromised. Error signals propagate unchecked upward, flooding the system with unprecedented levels of predictive uncertainty. This creates what we term "model shattering"—a cascade of destabilization in which the hierarchical generative model at each level becomes overwhelmed by errors that exceed its capacity to integrate (Bastos et al., 2012).

The deepest cortical layers (V and VI) are where the brain's most stable generative models reside. These layers contain dense recurrent connectivity—neurons connected to other neurons within the same layer—that allows sustained activity patterns. When you stimulate these neurons, activity persists; they do not simply respond and terminate. This persistent recurrent activity is what constitutes a stable prior or generative model. These deepest-layer priors are the slowest to change and the most fundamental to our sense of self. At the highest hierarchical level, these persistent activity patterns encode what we experience as meaning—the answer to the question "What is my life for?" When trauma or extreme stress causes model shattering, it is precisely these deepest-layer priors that become destabilized. The result is what patients describe as existential fragmentation: "The world stopped making sense. Everything is unpredictable. I don't know who I am."

2.3. Affective Criticality: How Emotion Regulates Hierarchical Organization

Emotion is conventionally understood as a feeling or subjective experience—joy, fear, sadness. But Don Tucker and Phan Luu have proposed a fundamentally different functional account: emotion is the regulatory heartbeat of hierarchical predictive processing (Tucker & Luu, 2021; Tucker, Luu, & Friston, 2025). In their framework, emotion implements precision-weighting—the allocation of computational weight or precision to different signals in the hierarchical system. Precision, in technical terms, is the inverse of variance or uncertainty. A signal with high precision is treated as reliable and is given substantial weight in computation. A signal with low precision is treated as uncertain and is given little weight. Emotion, in this view, is the mechanism through which the brain modulates which signals get treated as reliable and which as uncertain.

How does emotion accomplish this precision-weighting? Through the effects of neuromodulatory systems. Neurotransmitters like norepinephrine, dopamine, and serotonin modulate synaptic gain—the degree to which a neuron's output influences downstream neurons. Elevated levels of these neuromodulators (released during emotional arousal) increase synaptic gain, making certain signals more influential. Decreased levels reduce synaptic gain, allowing signals to be attenuated or ignored. Consider a concrete scenario: You are in a dangerous situation. Your amygdala (the brain's threat-detection system) is activated. This activation causes increased norepinephrine and dopamine release in sensory and attentional networks. The effect is that threat-relevant signals—a rustling sound, a shadow, an ambiguous movement—suddenly acquire high precision. Signals you would normally ignore (a distant bird song, a loving memory) are suddenly downweighted to low precision. This is emotion at work: reallocating the brain's computational resources to prioritize inputs relevant to the current threat.

Tucker and Luu identify two complementary limbic systems that implement this emotional regulation, with distinct anatomical origins and functional consequences (Tucker & Luu, 2021). The dorsal limbic system, which includes the hippocampus, anterior cingulate, mammillary body, and anterior thalamus (the so-called Papez circuit), is characterized by predominantly excitatory neurotransmitter tone (dopamine and norepinephrine). This system generates affective states of optimism, confidence, and forward drive. Functionally, it boosts the precision given to predictive priors—it makes you believe and trust your generative models. The phenomenology is: "I am confident. The future will be good. I can do this." The evolutionary function is reward-seeking and approach motivation.

The ventral limbic system, involving the amygdala, orbital prefrontal cortex, and mediodorsal thalamus (the Yakovlev circuit), is characterized by heightened sensitivity to error signals and inhibitory tone. This system generates affective states of anxiety, caution, and vigilance. Functionally, it boosts the precision given to error signals—it makes you doubt your generative models and scrutinize your predictions. The phenomenology is: "Something is wrong. I need to check my assumptions. Be careful." The evolutionary function is threat-detection and error-correction.

For optimal cognitive function, these two systems must maintain dynamic balance. Too much dorsal (Papez) activity results in rigidity—you trust your model too much, ignore disconfirming evidence, and become detached from reality. The clinical manifestation is mania or impulsive behavior, where confidence in one's model exceeds its actual accuracy. Too much ventral (Yakovlev) activity results in fragmentation—you don't trust any model, are overwhelmed by error signals, and become paralyzed by uncertainty. The clinical manifestation is depression, characterized by rumination and paralysis. The optimal state is what Tucker calls "criticality"—a dynamic balance poised between these two extremes.

Criticality, a concept borrowed from physics, refers to a system at a phase transition—the knife's edge between order and chaos, between stability and instability (Beggs & Plenz, 2003; Toker et al., 2022). At criticality, a system achieves maximal "dynamic range"—it can respond sensitively to small perturbations without diverging uncontrollably, and information propagates efficiently through the system. Neurally, criticality is characterized by specific signatures: long-range temporal correlations emerge, power-law distributions appear in activity patterns, and the ratio of excitation to inhibition (E/I balance) is precisely calibrated (Chialvo, 2010). Phenomenologically, when you are at criticality, consciousness feels vivid, flexible, and capable of integrating diverse information. This is the state associated with psychological health and wisdom—you have confidence in your beliefs but remain open to updating them based on new evidence.

What maintains criticality at the highest hierarchical level? This is where meaning enters the picture. A stable, coherent sense of meaning acts as a meta-regulator of affective balance. When you have a strong sense of meaning, you can tolerate high ventral (error-checking, anxiety) activity without fragmenting. Why? Because the error or threat is contextualized within a larger framework of purpose. A person with a strong meaning-prior can experience anxiety about a particular situation yet maintain overall coherence because the anxiety is embedded in a narrative that makes sense. "Yes, this is frightening, but it is part of my larger purpose, and I can integrate it." Conversely, loss of meaning means loss of this contextualizing frame. Error signals and threats cannot be integrated into

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a coherent narrative, so they fragment the system. The person experiences anxiety not as contextualized worry but as existential dread—meaning-unmoored fear that destabilizes the entire system.

2.4. Spatiotemporal Coherence: Time, Space, and Consciousness

Georg Northoff proposes a revolutionary thesis: time and space are not abstract categories through which the brain perceives reality, but the fundamental substrate through which the brain organizes itself (Northoff, 2018; Northoff & Huang, 2017). Consciousness does not arise from activity in particular brain regions (there is no "consciousness center" in the brain). Rather, consciousness arises from the brain's spatiotemporal structure—the way in which neural activity is organized across space and through time. Change the spatiotemporal organization, and you change consciousness itself.

This is not mysticism, but neuroscience grounded in measurable parameters. The brain maintains itself as a unified spatiotemporal structure in which neurons fire in precise temporal sequences across distributed spatial locations. Neurons do not fire in isolation; they fire in coordinated rhythms with other neurons far away. These distributed, temporally coordinated patterns constitute consciousness. When the spatiotemporal structure is intact—when activity across distant brain regions is temporally synchronized—consciousness is present and coherent. When the spatiotemporal structure fragments—when different regions fire at different times without coordination—consciousness fragments. This is what occurs in dissociation or anesthesia: the spatiotemporal coherence of the brain is disrupted.

How do we measure spatiotemporal coherence? One crucial measure is the autocorrelation window (ACW)—a metric of how long the brain "remembers" its own past activity. Technically, ACW is computed by correlating neural activity at time t with activity at time $t + lag$, and measuring how long this correlation persists before dropping below a threshold. A long ACW means the system maintains correlation with its past across extended durations—minutes, hours. A short ACW means correlation drops quickly—the system "forgets" its past within seconds or less.

The phenomenological significance of ACW is profound. A person with a long ACW experiences events as part of a continuous narrative. "Today's disappointment fits into my larger life story. I can see how it connects to my past and future." A person with a short ACW experiences time as a series of disconnected moments. "Everything feels isolated. I cannot connect this moment to what came before or what might come after." Trauma produces an acute shortening of ACW—victims become trapped in the present moment, unable to connect their current experience to larger temporal context. Healing from trauma involves gradual extension of ACW—reconnection to past experience and future possibility. Meaning-centered work facilitates this reconnection by providing the narrative framework within which isolated moments can be re-integrated.

A second crucial mechanism is infra-slow oscillations (ISOs)—brain rhythms in the extremely low-frequency range (0.01–0.1 Hz), slower than any other known brain oscillations (Northoff & Huang, 2017; Northoff, G., Wainio-Theberge, S., & Evers, K. (2020). These oscillations persist even during sleep and anesthesia and appear to be a fundamental organizing principle of brain function. ISOs are primarily observed in the default mode network (DMN), the brain's "self-referential" network that is active during internally-oriented cognition (thinking about yourself, imagining the future, remembering the past) and quiet during focused external tasks.

What do ISOs do functionally? They act as a temporal container—they modulate the amplitude of faster oscillations through a mechanism called phase-amplitude coupling. When an ISO is at a high-amplitude phase, faster brain rhythms (theta and gamma oscillations in the range of 4–100 Hz) can propagate freely. When an ISO is at a low-amplitude phase, faster rhythms are dampened. The metaphor is apt: the slow oscillation is like a ship's hull, and the fast oscillations are like water inside. The hull does not prevent turbulent water movement, but it structures and contains it, preventing the turbulence from dissipating chaotically into the sea.

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Why does this matter for trauma and meaning? Traumatic events produce massive, fast oscillatory activity in the brain—gamma-frequency discharge (40–100 Hz) characteristic of extreme arousal and threat-response. Without strong ISOs to contain this activity, the fast oscillations flood the system, causing dissociation and fragmentation. But with intact ISOs, the same fast activity is temporally structured and distributed, preventing destabilization. Meaning extends ISO strength. How? By anchoring the self-referential processing of the DMN in a coherent narrative. When you have meaning, the DMN generates a stable, temporally extended story of yourself. This narrative support strengthens ISO generation in the DMN, which then provides a stronger temporal container for processing stressful experiences.

Consciousness, in Northoff's framework, emerges at the intersection of spatial synchronization (activity coordinated across brain regions) and temporal coherence (activity maintaining long-range temporal correlations). Loss of consciousness corresponds to disruption of either dimension: loss of spatial synchronization (regions firing independently) or temporal fragmentation (short autocorrelation windows, loss of ISO-mediated coherence). This provides a neurobiologically testable account of consciousness that bridges phenomenology and neuroscience.

2.5. The Existential Dimension: Why Meaning Is a Biological Necessity

Viktor Frankl, as a psychiatrist imprisoned in Nazi concentration camps, made an observation that contradicted the survival predictions of both medicine and psychology. Survival was not predicted by health, strength, intelligence, or youth. Survival was predicted by meaning (Frankl, 1946/1984). Prisoners who maintained a clear sense of existential purpose—"I must see my family again," "I must complete my work," "I must bear witness to this atrocity"—survived. Prisoners who lost meaning often died, even when physically healthy and surrounded by the same resources as survivors. This was not romanticism or philosophy. For Frankl, this was empirical observation with profound implications: meaning is not a luxury but a necessity for human survival.

Why would Frankl, as a neurobiologist, take this observation so seriously? Because he understood that the brain is an energy-consuming organ operating under resource constraints. In conditions of severe deprivation (starvation, disease, extreme stress), survival depends on metabolic efficiency. If meaning somehow made the brain more efficient at processing adversity, this would be a biological fact, not a philosophical one. And indeed, neuroscience now suggests precisely this.

From a neurobiological perspective, what is meaning? At the deepest level, meaning is the highest-order generative model—the stable, coherent set of beliefs and narratives that anchor the entire hierarchical predictive system. It is the answer to the existential questions: "What is my life for? What makes my existence coherent? What values organize my choices?" This highest-level prior constrains all lower-level predictions and interpretations. A person with a strong meaning-prior can interpret ambiguous situations in ways that fit their larger narrative. A person without a stable meaning-prior is left without a framework for interpretation, and every ambiguous situation produces existential anxiety.

Why does a stable highest-level prior reduce metabolic cost? Consider the alternative: a person without stable meaning faces each aversive experience (loss, failure, pain, rejection) as a threat to the entire self-model. Each aversive experience demands a comprehensive reassessment: "Who am I? What is my life about? What should I do?" This requires continuous recomputation of the entire generative model—metabolically catastrophic under resource constraints. In contrast, a person with stable meaning can integrate the same aversive experiences into an existing framework: "This loss makes sense within my larger purpose. This failure does not undermine who I am. I can integrate this into my narrative." No need to rebuild; just update. Metabolically efficient.

Mathematically, this efficiency is captured by the Free Energy Principle. Recall that Free Energy = Complexity − Accuracy. When a person has a stable meaning-prior, complexity is low (they do not have to change their fundamental beliefs). When a person lacks stable meaning, complexity is high (they must constantly rebuild their self-model). Free energy is minimized (survival probability maximized) when a stable meaning-prior is present. This is not metaphorical. It is the thermodynamic

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explanation for Frankl's observation: meaning minimizes free energy, thereby maximizing survival probability.

In Bayesian terms, this is the power of strong priors. A person with a strong meaning-prior can integrate the same amount of negative information with less destabilization than someone without a prior. Consider two people losing their job. Person A interprets this as "I am worthless. My life is meaningless. I should give up." This interpretation requires complete identity reconstruction—existentially catastrophic. Person B interprets this as "This is a setback in my larger life purpose. I can learn from this and move forward." This interpretation requires mere adjustment within an existing framework. Person B survives with less metabolic cost.

What happens when meaning collapses? If meaning is the highest-order organizing principle, then its collapse destabilizes the entire hierarchy. Trauma does not just create a "bad memory." It can shatter the framework through which the person makes sense of reality. Patients describe this as existential crisis: "My identity has collapsed. Nothing makes sense anymore. I don't know who I am." Neurobiologically, this is model shattering at the highest level. When the highest-order generative model (meaning-prior) is overwhelmed by prediction errors that exceed its capacity to integrate, it fragments. All lower levels, which depend on the stability of that highest level, cascade into dysfunction.

This is the bridge between existential psychology and neuroscience: Frankl observed that meaning is necessary for psychological survival. Neuroscience explains why: because meaning is the organizing principle of the hierarchical predictive system. When meaning is present: the system is stable, efficient, resilient. When meaning is absent: the system is fragmented, inefficient, vulnerable. Meaning is not epiphenomenal—a luxury after more basic needs are met. Meaning is a thermodynamic necessity for hierarchical organization.

Section 3: The Neas Model and Its Clinical Implications

3. Three Mechanisms Through Which Meaning Stabilizes Resilience

3.1. Model Shattering and Reconstruction: How Meaning Scaffolds Recovery from Trauma

The term "model shattering," introduced in Section 2.2, describes a specific neurobiological cascade that occurs when traumatic events generate prediction errors that exceed the brain's capacity to integrate them. In normal functioning, the hierarchical predictive system responds to modest prediction errors through learning—the model updates its priors, incorporates the new information, and stabilizes. But in trauma, the prediction error is often massive and sudden. A betrayal by a trusted person, a life-threatening assault, the unexpected death of someone essential—these events contradict the entire framework through which the person understood reality. They are not merely pieces of surprising information to be integrated into an existing model. They shatter the model itself.

What happens neurobiologically during model shattering? Following severe trauma, the brain's deepest cortical layers (where the most stable priors reside) become overwhelmed by error signals. Stress hormones impair the normal gating mechanisms that would ordinarily modulate the intensity of these signals. The recurrent activity patterns in deep layers that constitute the generative model become chaotic. For the person, this manifests as existential fragmentation: "The world stopped making sense. I don't know who I am. Everything is unpredictable." The traumatic memory becomes "dysfunctionally stored" in the sense that it cannot be integrated into the existing autobiographical narrative—it remains isolated, hyperactive, and re-triggerable (van der Kolk, 2014; Ecker et al., 2012).

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Table 2. Three-Level NEAS Architecture with Clinical Manifestations.

Level & Focus	Neurobiological Organization	Key Mechanisms	Healthy Manifestation (Resilience)	Pathological Manifestation (Dysregulation/Fragmentation)
LEVEL 0: SENSORIMOTOR REGULATION	Local neural circuits; neurotransmitter systems; autonomic physiology; somatic markers	Neurotransmitter regulation; synaptic plasticity; physiological homeostasis; threat response calibration	Calm, regulated nervous system; appropriate physiological response to threat; efficient parasympathetic recovery; embodied sense of safety	Chronic dysregulation; persistent arousal; impaired parasympathetic recovery; somatic symptoms (pain, tension); hypervigilance
LEVEL 1: NARRATIVE AND IDENTITY	Autobiographical memory systems; identity representations; narrative coherence networks; hippocampal-cortical integration	Memory reconsolidation; narrative self-organization; temporal continuity of autobiographical memory; identity integration	Coherent life story connecting past-present-future; stable identity; integrated autobiography; sense of narrative continuity; ability to contextualize events within larger life arc	Narrative fragmentation; dissociation; identity confusion; temporal isolation ("stuck in the moment"); traumatic memory isolation; inability to connect past to present
LEVEL 2: EXISTENTIAL MEANING	Meaning-priors; value systems; existential purpose; existential coherence networks; highest-level generative models	Downward causation through meaning-priors; existential generative modeling; coherent worldview integration; values-aligned action	Clear sense of life purpose; coherent existential worldview; values-aligned living; existential resilience; ability to contextualize suffering within meaningful framework	Loss of meaning; existential crisis; nihilism; disconnection from purpose; "nothing makes sense"; inability to find coherence in experience; existential dread; existential fragmentation

The table shows how the NEAS comprises three hierarchically organized levels, each with distinct neurobiological organization, key mechanisms, and characteristic manifestations of health versus pathology. Trauma and extreme stress produce "model shattering"—simultaneous fragmentation across all three levels. Healthy functioning requires coherence at all three levels; dysregulation at the highest level (meaning) cascades through downward causation to destabilize lower levels. Recovery requires intervention addressing all three levels: physiological regulation (Level 0), narrative integration (Level 1), and meaning reconstruction (Level 2).

Contemporary research on memory reconsolidation has revealed that traumatic memories, once destabilized through reactivation, enter a window of malleability during which they can be updated, modified, or even partially erased (Beckers & Kindt, 2017; Kredlow et al., 2022). This is not "forgetting" in the sense of erasing the facts of what happened. Rather, it is decoupling the emotional intensity from the memory. A person can know intellectually that a trauma occurred while no longer experiencing the emotional re-experiencing and fragmentation that trauma produces. The therapeutic implication is that successful trauma recovery requires: (1) reactivation of the traumatic

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memory to make it malleable, (2) introduction of corrective information that contradicts the trauma's prediction—what Ecker and others term "prediction error during reconsolidation" (Ecker et al., 2012)—and (3) integration of the memory into a coherent narrative that makes sense of the trauma within a larger framework.

This is where meaning becomes essential for recovery. A person with a coherent meaning-framework can integrate the trauma into their narrative: "This terrible thing happened, and it has changed me profoundly, but it does not negate who I am. I can make sense of this within the larger context of my life and values." This narrative contextualization provides the "corrective information" that the reconsolidation window requires. Without stable meaning, the trauma remains isolated, unintegrated, continually re-triggering the cascade of destabilization.

Research on posttraumatic growth—positive psychological change following struggle with highly challenging life circumstances—demonstrates that recovery is not merely about symptom reduction or returning to baseline. Rather, it is often about reconstructing meaning in light of the trauma (Tedeschi & Calhoun, 2004; Jayawickreme, 2021). Individuals who report posttraumatic growth typically develop altered perspectives on themselves ("I am stronger than I thought"), on relationships ("What matters is connection, not status"), and on existential purpose ("Life is fragile; I must live according to my values"). These reframes are not false reassurances. They are profound reorganizations of the highest-level generative models—the meaning-priors—that allow the trauma to be integrated without defining the entire self.

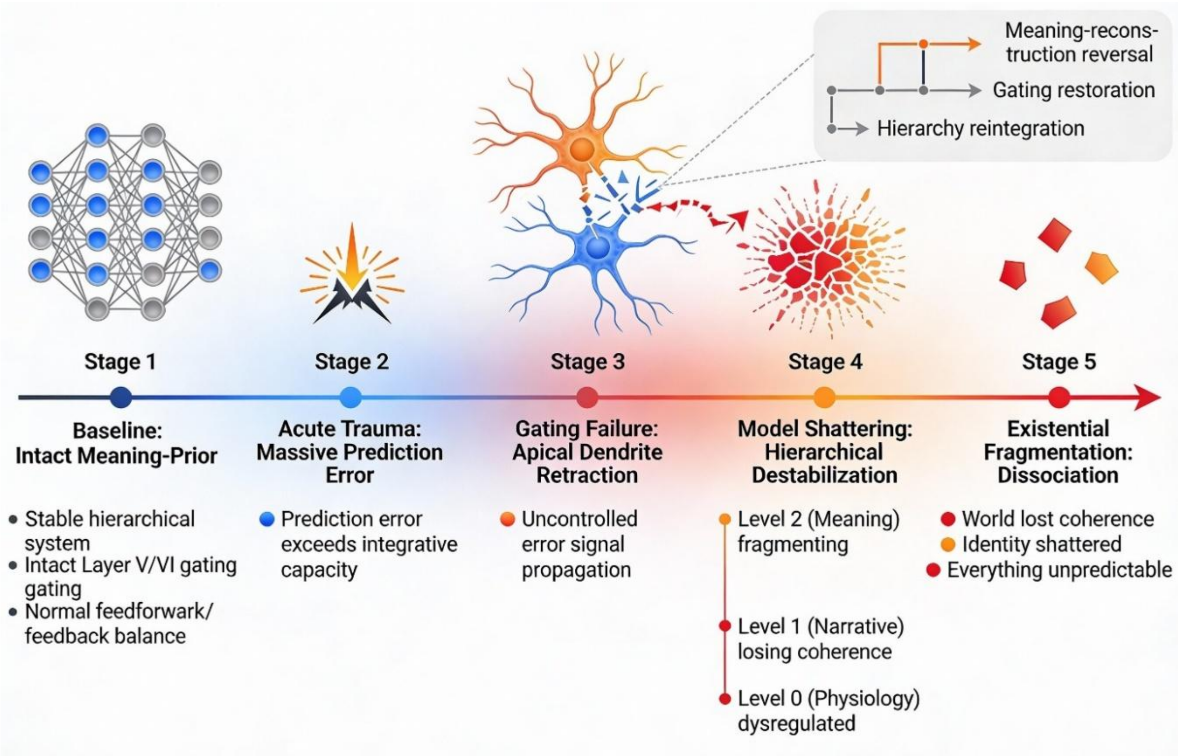

Figure 2. Model Shattering Cascade.

From Intact Hierarchy to Existential Fragmentation. Stage 1 (Baseline): Intact meaning-prior, stable hierarchical organization, functional feedforward/feedback balance, intact Layer V/VI top-down gating. Stage 2 (Acute Trauma): Massive prediction error that exceeds the brain's integrative capacity (e.g., violent assault, profound betrayal, sudden death of loved one). Stage 3 (Gating Collapse): Stress hormones (cortisol, adrenaline) induce apical dendrite retraction in Layer V/VI pyramidal neurons, impairing the normal gating mechanisms that modulate error signal propagation. Stage 4 (Model Shattering): Unmodulated error signals cascade upward through the hierarchical system, destabilizing generative models at each level. The highest-level model (meaning-prior) becomes overwhelmed and fragmented. Stage 5 (Existential Fragmentation): Phenomenological breakdown: "The world lost coherence," "I don't know who I am," "Everything is unpredictable." The traumatic memory remains isolated, hyperactive, and re-triggerable. Recovery requires meaning-reconstruction (inset), which provides a stabilizing framework that scaffolds restoration of Layer V/VI gating capacity and progressive reintegration of the hierarchical system.

3.2. Affective Criticality and the Maintenance of Balance: How Meaning Prevents System Collapse

The second mechanism through which meaning stabilizes resilience operates through the maintenance of affective criticality. Recall from Section 2.3 that the dorsal limbic system (Papez circuit) boosts confidence in predictive models (Dorsal tone: "Trust your model"), while the ventral limbic system (Yakovlev circuit) heightens sensitivity to errors (Ventral tone: "Be skeptical, check your assumptions"). In optimal functioning, these two systems maintain dynamic balance—what Tucker termed "criticality." But under severe stress, this balance is threatened. Chronic threat activates the ventral system persistently, leading to continuous error-checking, doubt, and eventually paralysis (depression). Alternatively, some individuals respond to chronic threat by upregulating the dorsal system, leading to denial, rigidity, and detachment from reality (mania, impulsivity).

Loss of meaning exacerbates this dilemma. Without a stable meaning-prior to contextualize threat, the ventral system's error-checking signals cannot be integrated into a coherent narrative. Every error signal becomes existentially frightening. "Something is wrong" cascades into "everything is wrong" and "I am nothing." The system loses criticality—it can no longer maintain the balance between confidence and skepticism. In neurophysiological terms, the E/I (excitation/inhibition) balance that characterizes criticality collapses (Beggs & Plenz, 2003; Toker et al., 2022).

Meaning acts as a meta-stabilizer of this balance. When you have a strong sense of life purpose, you can tolerate high ventral (error-checking, anxiety) activity without fragmenting. The anxiety is contextualized: "Yes, this is frightening, and I am anxious about this particular threat. But this anxiety is part of my response to a challenge that fits within my larger purpose. I can integrate it." The meaning-prior provides a frame stable enough to hold the anxiety without the anxiety destabilizing the entire system.

Clinically, this has profound implications. Interventions that aim only at reducing anxiety (through anxiolytics or breathing techniques) may provide short-term relief but leave the underlying criticality problem unsolved. If the person still lacks a stable meaning-prior, anxiety will re-emerge whenever new threats appear. In contrast, interventions that rebuild meaning-structures—meaning-centered therapy, existential approaches, logotherapy in Frankl's sense—address the root problem: they restore the high-level prior that allows the system to rebalance around criticality.

3.3. Spatiotemporal Coherence: How Meaning Extends the Temporal Integration Window

The third mechanism through which meaning stabilizes resilience operates at the level of spatiotemporal coherence. Recall from Section 2.4 that consciousness depends on temporal coherence—the brain's ability to integrate activity across extended time windows (long autocorrelation windows) and to modulate fast oscillations through slow (infra-slow) oscillations. Trauma produces acute shortening of autocorrelation windows. Victims become trapped in the present moment, unable to connect current experience to past or future: "Everything happens in isolation. I cannot see how today connects to yesterday or tomorrow."

Meaning extends the autocorrelation window by providing narrative continuity. When you have a meaning-prior, your mind automatically places events within a larger story: "Today's disappointment is part of my larger life trajectory toward [meaningful goal]. I can see how it connects to my past efforts and future possibilities." This narrative structuring literally extends the temporal window over which the brain integrates information. The person experiences time not as fragmented moments but as a coherent narrative arc.

At the neurophysiological level, this corresponds to strengthened infra-slow oscillations (ISOs) in the default mode network. The DMN is responsible for self-referential processing—thinking about yourself, your future, your meaning. When you engage in meaning-making (narrative therapy, reflection on life purpose, existential exploration), you are directly activating the DMN and strengthening its ISO generation. Stronger ISOs then provide a better temporal container for processing stressful or traumatic information. The traumatic error signal is no longer a chaotic, isolated burst of activity. It is temporally structured and distributed, preventing dissociation and fragmentation.

3.4. Therapeutic Implications: Three-Level Intervention

The NEAS model generates a coherent approach to therapeutic intervention organized around three hierarchical levels, each corresponding to the architectural levels identified in Section 2.1.

Level 0 (Sensorimotor): Physiological Regulation At this lowest level, therapeutic work focuses on stabilizing the nervous system's physiological responses to threat. This includes psychopharmacological interventions (SSRIs to normalize monoamine levels, anxiolytics for acute anxiety), somatic therapies (sensorimotor psychotherapy, somatic experiencing), and polyvagal-informed approaches that engage the parasympathetic nervous system to restore a sense of safety (Geller & Porges, 2014). These interventions are necessary but insufficient. They address symptoms but leave the organizing principles (meaning) unaddressed.

Level 1 (Narrative): Identity and Story Reconstruction. At this intermediate level, therapeutic work focuses on rebuilding autobiographical narrative coherence. This includes trauma-focused cognitive therapy, narrative therapy, and memory reconsolidation approaches. These interventions aim to integrate the traumatic memory into the person's life story in a way that makes sense and does not define the entire identity. Recent research on memory reconsolidation has shown that when traumatic memories are reactivated within a therapeutic relationship, they become malleable and can be updated with corrective information (Beckers & Craske, 2017; Lee, 2009). The goal is not to erase the memory but to decouple its emotional intensity from its factual content, allowing the person to know what happened without being re-traumatized by the knowing.

Level 2 (Existential): Meaning Reconstruction At this highest level, therapeutic work focuses on the reconstruction or development of existential meaning. This is not a luxury added after "real" therapy is done. It is foundational. This level includes existential psychotherapy, logotherapy, meaning-centered interventions, and spiritual/philosophical exploration. The therapeutic task is to address the question: "What is my life for? What values are worth organizing my life around? How do I make sense of my existence given what I have experienced?"

The three-level model suggests that sustainable healing requires attention to all three levels. A person can achieve physiological stability (Level 0) without narrative coherence (Level 1) or meaning (Level 2)—they feel calm but empty. A person can achieve narrative coherence without meaning—they have a coherent life story but lack a sense of purpose. Only when meaning is present does the system achieve genuine resilience: stability that is not merely the absence of symptoms but the presence of coherence and purpose.

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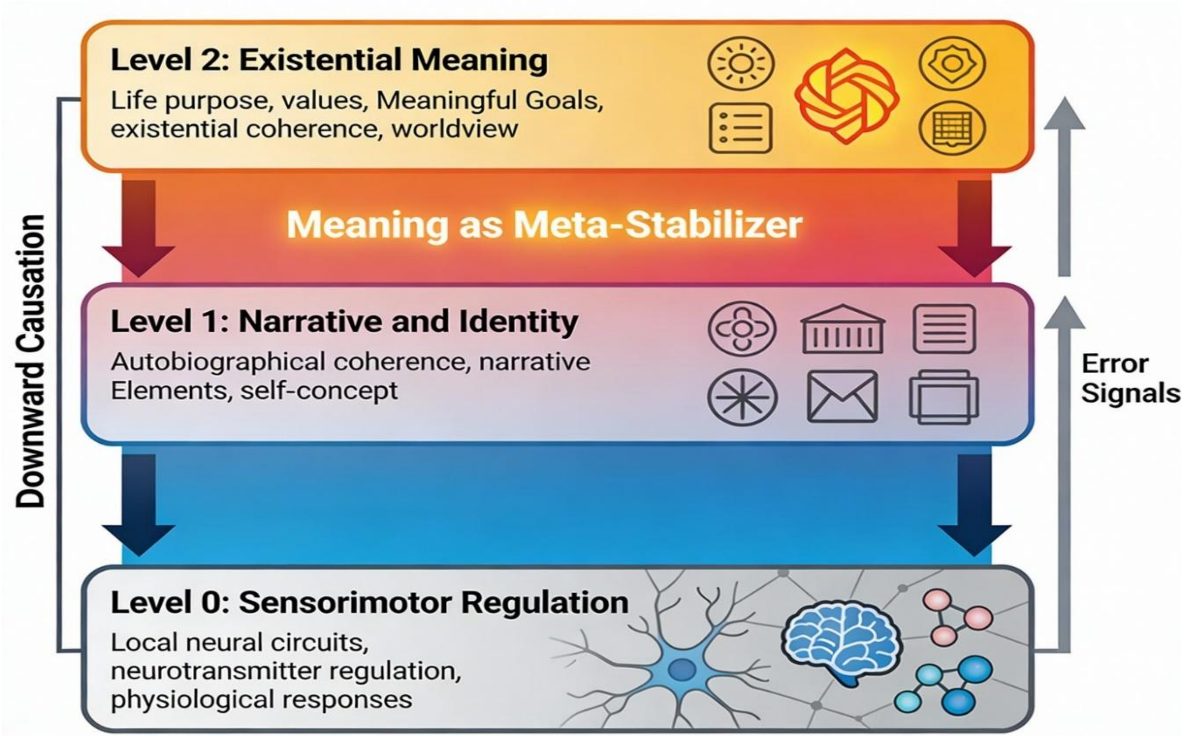

Figure 3. Three-Level NEAS Architecture.

Hierarchical Organization of Meaning and Resilience. Level 0 (Sensorimotor) comprises local neural circuits and physiological regulation. Level 1 (Narrative) encompasses autobiographical coherence, narrative elements, and identity integration. Level 2 (Existential) represents meaning, values, meaningful goals, and existential purpose. Downward causation from meaning (Level 2) stabilizes lower levels through precision-weighting and constraint. Upward error signals from lower levels inform the stability of higher-level meaning structures. When meaning-level priors are stable, the entire hierarchy maintains coherence and resilience.

3.5. Therapeutic Presence as Neural Synchronization

A final clinical implication concerns the role of therapeutic presence—the therapist's capacity to be fully attentive, authentic, and responsive in the moment with the client. Research on therapeutic presence has demonstrated that it is one of the most reliable predictors of therapeutic outcome, across different theoretical orientations (Geller & Porges, 2014). But why?

The NEAS model provides a neurobiological mechanism. When a therapist is truly present—fully attentive, responsive, attuned—they are engaging the client's neuroception system (the brain's unconscious detection of safety versus threat). Through facial expressions, prosodic vocalizations, bodily gestures, and the quality of attention, the present therapist communicates safety at a pre-conscious level. The client's ventral limbic system (Yakovlev circuit) is downregulated; the dorsal system (Papez circuit) is activated. The client enters a state closer to criticality—they can tolerate reflecting on threat and pain without fragmenting because the therapist's presence provides external regulation that supplements their own internal regulatory capacity.

But there is more: the therapist's presence also provides a model for the reconstruction of meaning. In existential terms, the therapist embodies the possibility of meaning. By being fully present with the client's suffering—not fleeing it, not minimizing it, but witnessing it with genuine interest and respect—the therapist demonstrates that suffering can be held within a coherent framework of care and attention. This modeling, repeated across sessions, scaffolds the client's reconstruction of their own meaning-framework. The client learns: "My suffering can be witnessed and contextualized. It does not negate my worth. It is part of my human experience, and it can be integrated."

3.6. Falsifiable Predictions and Empirical Roadmap

The NEAS model generates multiple empirically testable predictions. Four key predictions are outlined below:

Prediction 1: Autocorrelation Window Extension and Meaning Individuals who undergo meaning-centered therapeutic work (existential therapy, logotherapy, meaning reconstruction) should show measurable extension of autocorrelation windows (ACW) in EEG and fMRI, with longer ACW correlating with both reduced trauma symptoms and increased sense of life purpose. This prediction is testable through longitudinal neuroimaging in trauma survivors receiving meaning-centered versus symptom-focused interventions.

Prediction 2: Infra-Slow Oscillation Strengthening and Meaning Engagement in meaning-making activities (narrative work, spiritual practice, existential exploration) should correspond to strengthened infra-slow oscillations (ISOs) in the default mode network, measurable through low-frequency fMRI analysis. Stronger ISOs should predict better response to trauma processing and greater resilience to new stressors.

Prediction 3: Model Shattering as Laminar Disruption Acute trauma should produce measurable disruption in the normal laminar organization of predictive signaling—specifically, impaired top-down gating in layer V neurons, correlating with subjective reports of "the world losing coherence." Recovery from trauma should correspond to restoration of normal laminar organization, which can be accelerated by interventions that stabilize meaning-priors.

Prediction 4: Three-Level Intervention EfficacyTherapeutic interventions that target all three levels (physiological + narrative + existential) should produce superior long-term outcomes compared to single-level interventions, with effect sizes larger for meaning-inclusive approaches in samples with existential suffering (treatment-resistant depression, existential crisis) than in samples with primarily biological dysregulation.

Section 4: Discussion, Limitations, and Future Directions

4.1. What the NEAS Model Accomplishes

The Neuro-Existential Architecture System integrates five previously disparate theoretical domains—Friston's Free Energy Principle, Melloni's laminar architecture, Tucker's affective criticality, Northoff's spatiotemporal neuroscience, and Frankl's existential psychology—into a coherent framework explaining how meaning stabilizes resilience at the neurobiological level. This synthesis makes three core contributions to psychiatric science and philosophy.

First, the NEAS bridges a persistent explanatory gap between neuroscience and existential psychology. For decades, these disciplines have operated in separate intellectual worlds, with neuroscience explaining mechanisms while existential psychology explained meaning. The NEAS proposes that they are not separate domains but different perspectives on unified phenomena. Meaning is not epiphenomenal—a secondary experience that "occurs" when particular brain states are active. Rather, meaning is the highest-order organizing principle of the hierarchical predictive system. This is not a mystical claim but a neurobiologically grounded one: the stable, high-level generative models that constitute meaning are thermodynamically necessary for hierarchical organization to function.

Second, the NEAS provides a mechanistic account of why meaning matters for resilience and survival. Frankl's clinical observation—that meaning predicts survival in extreme adversity—is explained not as philosophical truth but as thermodynamic necessity. The Free Energy Principle predicts that systems with stable, high-level priors are more metabolically efficient. Meaning is that highest-level prior. This provides a scientific language for one of psychology's most profound insights: humans can endure suffering they can make sense of within a meaningful framework, but find meaningless suffering intolerable.

Third, the NEAS generates a testable, falsifiable model. Unlike some theoretical proposals that remain perpetually abstract, the NEAS makes specific predictions about neurobiological mechanisms (laminar disruption in trauma, ISO extension with meaning, ACW lengthening with healing) that can be empirically tested. This transforms meaning from philosophical abstraction to scientific proposition.

4.2. Limitations: What the NEAS Is Not and Cannot Yet Explain

Critical acknowledgment of limitations is essential for scientific integrity. The NEAS, for all its integrative power, operates within significant constraints.

The Problem of Heterogeneity. Contemporary neuroimaging research has revealed that psychiatric disorders show profound biological heterogeneity. Individuals diagnosed with the same disorder (depression, anxiety, PTSD) show widely divergent neurobiological patterns. Wolfers and colleagues (2019) demonstrated using normative modeling approaches that individual patients with ADHD show brain structural differences that do not overlap; only 2% or less of patients share the same regional abnormalities. This heterogeneity—multiplicity of causal pathways to similar clinical presentations—is a fundamental challenge for any unified neurobiological model. The NEAS does not yet specify how individual variation in neurobiological architecture relates to individual meaning-processing capacities. Does a person with a hyperactive amygdala have a different relationship to meaning-making than someone with hypoactive prefrontal-limbic connectivity? The model is agnostic on this crucial question.

The Reductionism Challenge. Critics of biological psychiatry have long argued that attempts to explain psychological suffering purely through neurobiological mechanisms constitute inappropriate reductionism (Insel & Cuthbert, 2015; Szasz, 2010). The NEAS, by grounding meaning in neurobiological architecture, risks this critique. One could argue that the model reduces existential meaning to "merely" a pattern of neural activity, thereby losing something essential about meaning's subjective, intentional, lived quality. The NEAS cannot fully resolve this philosophical problem. It can demonstrate that meaning correlates with and depends on specific neurobiological processes, but the question of whether meaning is reducible to those processes remains a metaphysical rather than empirical question. What the NEAS can claim is that it avoids naive reductionism by showing how higher-level (psychological, existential) processes exercise downward causation on lower levels—meaning is not just the product of neurobiology but an organizing principle that shapes neurobiological function.

Individual Differences and Operationalization. The NEAS proposes meaning as a "highest-level prior" but does not yet specify how to operationalize this concept in neurobiological terms. What neurobiological signatures distinguish a person with a "strong meaning-prior" from one with a "weak" or "fragmented" meaning-prior? Is it measurable through specific brain regions? Distributed network patterns? The model identifies mechanisms but remains underspecified on measurement. This is a crucial limitation for empirical testing. To advance the NEAS from a heuristic framework to a rigorous empirical program, the "highest-level meaning-prior" must be operationalized through a multi-modal approach that bridges subjective phenomenology with neurobiological parameters. While the model identifies the *function* of this prior, its *magnitude* and *stability* can be quantified using established psychometric instruments in tandem with the proposed neuroimaging markers.

Specifically, the Meaning in Life Questionnaire (MLQ; Steger et al., 2006) and the Purpose in Life Test (PIL; Crumbaugh & Maholick, 1964) serve as primary candidates for establishing a quantitative baseline. Within the NEAS architecture, the Presence of Meaning subscale (MLQ) is hypothesized to map onto the robustness of infra-slow oscillations (ISOs) within the Default Mode Network (DMN). A high "Presence" score would indicate a stable existential generative model, which the NEAS predicts will manifest as higher ISO amplitude and stronger phase-amplitude coupling, effectively "containing" lower-level prediction errors.

Furthermore, the Search for Meaning subscale (MLQ) and scores indicating an existential vacuum (PIL) provide a measure of prior instability or fragmentation. In clinical samples, the NEAS predicts a significant inverse correlation between existential vacuum scores and the length of the autocorrelation window (ACW). Individuals reporting a lack of purpose are expected to exhibit

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shorter ACWs, reflecting a diminished capacity for temporal integration and a predictive system that is "stuck" in a fragmented, moment-to-moment processing mode.

By utilizing Latent Variable Modeling (LVM; e.g., Bollen, 1989), researchers can integrate these psychometric scores with laminar-specific fMRI data. This allows for the testing of whether the "Meaning Factor" (derived from MLQ/PIL) statistically mediates the relationship between Layer V/VI gating efficiency and overall clinical resilience.

Social and Systemic Dimensions. The NEAS focuses on individual neurobiological architecture and individual meaning-making. But meaning is not purely individual. It is deeply embedded in social contexts, cultural frameworks, and systemic conditions. While the NEAS provides a robust account of the internal neurobiological architecture of meaning, it is essential to acknowledge that the "highest-order priors" do not emerge in isolation. Rather, they are deeply embedded within and scaffolded by broader sociocultural meta-structures (Kirmayer. 2024). Meaning-making is inherently a distributed process; cultural narratives, communal values, and collective identities provide the external framework—the "social scaffold"—within which individual predictive models are calibrated (Seligman & Kirmayer, 2008).

In this expanded view, sociocultural systems act as "meta-priors" that stabilize the individual's hierarchical organization. A coherent cultural or spiritual framework provides the narrative resources necessary for the brain to integrate aversive experiences without cascading into model shattering. Conversely, systemic stressors—such as institutionalized oppression, socio-economic marginalization, or the erosion of collective purpose—can be understood as structural constraints that impair an individual's meaning-making capacity.

By integrating these social determinants, the NEAS can account for why resilience often flourishes within supportive communities: the collective provides a stabilizing "buffer" that maintains the individual's affective criticality even when internal resources are depleted (Jetten et al., 2012). This perspective shifts the focus from a purely neuro-centric model to a socio-existential ecosystem, where genuine healing involves the alignment between internal neurobiological coherence and external social meaning.

A person may maintain individual meaning-coherence while living in conditions of systematic oppression, marginalization, or deprivation. The NEAS does not adequately address how social trauma, structural inequality, or systemic meaninglessness constrains individual meaning-making capacity. This is not a failure of the model itself but a limitation of scope: the NEAS addresses neurobiological mechanisms without fully integrating social determinants of mental health.

Causality and Temporal Dynamics. The NEAS proposes that meaning stabilizes neural hierarchy, but the precise causal and temporal relationships remain unclear. Does meaning recovery precede neural reorganization, follow it, or occur simultaneously? The model suggests bidirectional causation (meaning shapes neural organization, which enables further meaning-integration), but empirical tests of these temporal dynamics are lacking. Longitudinal neuroimaging studies measuring both brain states and meaning over time are needed to clarify these relationships.

4.3. Falsification Scenarios: What Evidence Would Disprove the NEAS?

Science advances through clear identification of what evidence would falsify a theory. The NEAS generates specific falsification scenarios.

Scenario 1: Meaning-Independent Resilience. If substantial numbers of trauma survivors recover without reconstructing coherent meaning—if ACW extension occurs without narrative integration, if neurobiological healing proceeds without existential resolution—this would challenge the NEAS claim that meaning is fundamental to resilience. Such cases would suggest that meaning is one pathway to recovery, not a necessary organizing principle. Empirical test: Longitudinal studies measuring both neurobiological markers (ACW, ISOs, laminar function) and existential meaning in trauma survivors. Falsification threshold: If >30% of survivors show normalization of ACW without increased meaning endorsement on standardized measures.

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Scenario 2: Neurobiological Sufficiency. If psychopharmacological interventions (SSRIs, anxiolytics) alone could sustainably restore well-being without meaning-centered work, this would suggest that neurobiological regulation is sufficient and that meaning is secondary. The NEAS predicts that Level 0 interventions alone will produce symptom relief but not lasting resilience or subjective well-being. Falsification threshold: If treatment-resistant depression samples show equivalent long-term recovery rates with pharmacotherapy alone versus pharmacotherapy + meaning-centered therapy.

Scenario 3: Laminar Dissociation. The NEAS predicts that trauma produces measurable disruption in laminar organization of feedforward/feedback signaling. If advanced neuroimaging shows intact laminar organization in individuals with severe existential fragmentation, or conversely, if severe laminar disruption occurs without existential symptoms, this would challenge the model's core mechanism. Falsification threshold: If layer-specific fMRI studies show no correlation between laminar disruption indices and phenomenological reports of "world losing coherence."

Scenario 4: ISO Independence from Meaning. The NEAS claims meaning extends infra-slow oscillations in the default mode network. If ISO strength remains constant or even increases in individuals experiencing profound meaninglessness, or if meaningfully engaged individuals show no ISO enhancement, the causal relationship would be questioned. Falsification threshold: If longitudinal low-frequency fMRI shows <0.3 correlation between meaning scores and ISO amplitude measures in clinical samples.

Table 3. Four Falsifiable Predictions and Empirical Tests.

Prediction	Neurobiological Mechanism	Measurement Methodology	Expected Finding	Falsification Threshold
Prediction 1: Autocorrelation Window Extension	Meaning-reconstruction stabilizes longest-range temporal correlations in neural activity through top-down constraint	Longitudinal EEG or fMRI in trauma survivors; compute autocorrelation windows (ACW) at baseline, post-meaning-centered therapy, and follow-up; compare to symptom-focused therapy control	Autocorrelation windows significantly extend in meaning-centered therapy group compared to symptom-focused control; ACW extension correlates with increased sense of life purpose on standardized meaning measures	If fewer than 30% of trauma survivors show measurable ACW extension after meaning-centered therapy; or if ACW extension does not correlate with meaning endorsement
Prediction 2: Infra-Slow Oscillation Strengthening	Meaning-making anchors default mode network self-referential processing, strengthening ISO generation that scaffolds error signal processing	Low-frequency fMRI (0.01–0.1 Hz bandpass filtering) in default mode network during meaning-oriented tasks; measure ISO amplitude before and after existential therapy; correlate with meaning scores	ISO amplitude increases measurably with engagement in existential reflection tasks; stronger correlations between meaning scores and ISO amplitude in clinical populations; ISO strengthening predicts better	If correlation between standardized meaning scores and ISO amplitude measures is less than 0.3 across clinical samples; or if ISO amplitude remains stable despite increased meaning endorsement

			response to trauma processing	
Prediction 3: Model Shattering as Laminar Disruption	Acute trauma impairs Layer V/VI gating mechanisms; recovery requires restoration of normal laminar-specific organization of feedforward/feedback signaling	Layer-specific 7-Tesla fMRI during trauma cues in PTSD patients; measure feedforward-to-feedback signal ratio in each cortical layer; measure apical dendrite integrity via high-resolution structural MRI	Layer V shows measurably reduced top-down gating capacity in severe PTSD; trauma recovery correlates with restoration of Layer V/VI gating function; gating capacity predicts symptom severity	If Layer V/VI gating mechanisms remain functionally intact in severe PTSD or existential fragmentation; or if severe laminar disruption occurs without existential symptoms
Prediction 4: Three-Level Intervention Efficacy	Meaning-centered work simultaneously stabilizes all three levels; single-level interventions leave system vulnerable to re-destabilization	Randomized controlled trial (RCT) design: control (standard care) vs. Level 0+1 (pharmacotherapy + trauma-focused therapy) vs. Level 0+1+2 (pharmacotherapy + trauma-focused therapy + existential therapy); measure outcomes at 6, 12, and 24 months	Level 0+1+2 group shows superior long-term resilience, reduced relapse, higher well-being, and better meaning scores compared to Level 0+1; effect sizes larger for existential suffering subsamples	If single-level interventions produce equivalent long-term recovery rates as three-level intervention; or if meaning-centered therapy shows no advantage over standard care in treatment-resistant populations

The NEAS generates four core predictions regarding mechanisms of trauma recovery, meaning, and resilience. Each prediction specifies the underlying neurobiological mechanism, precise measurement methodology using current neurotechnologies, expected empirical findings, and explicit quantitative threshold for falsification. This table provides a concrete empirical roadmap for advancing the field and testing the theoretical propositions of the NEAS model. All predictions are testable with existing neuroimaging and psychometric methods in clinical populations.

4.4. Future Empirical Directions

Despite these limitations, the NEAS opens multiple concrete research pathways.

Longitudinal Neuroimaging in Trauma Recovery. Prospective studies following trauma survivors through recovery, measuring ACW, ISO strength, and laminar function alongside phenomenological meaning-making. Interventions would be randomly assigned to control (standard care), Level 0+1 (pharmacotherapy + CBT), or Level 0+1+2 (with existential therapy). The hypothesis: Level 0+1+2 would show superior neurobiological reorganization signatures (ACW extension, ISO strengthening) and superior long-term outcomes.

Layer-Specific fMRI in Acute Trauma. High-field 7-Tesla fMRI capturing laminar-specific responses to trauma cues. Hypothesis: Acute stress or trauma reminders would produce impaired top-down gating in layer V, with recovery involving restoration of layer V gate function. Meaning-reconstruction would correlate with normalization of laminar function.

Memory Reconsolidation and Meaning. Building on existing reconsolidation research, studies would measure whether meaning-centered reframing during reconsolidation windows accelerates symptom recovery compared to fact-focused reframing alone. Hypothesis: Corrective information introduced during the reconsolidation window is more effectively integrated when framed within a larger meaning narrative than when presented as isolated factual correction.

Clinical Phenotyping for Meaning Deficiency. Development of neurobiological markers of "existential fragmentation"—dysregulation specifically characterized by loss of meaning rather than biological depression per se. This would support Research Domain Criteria approaches that cut across traditional diagnostic categories to identify individuals for meaning-centered interventions.

4.5. Conclusion: Toward a Science of Meaning in Psychiatry

For more than a century, psychiatry has asked: What is wrong with the brain? This question has produced genuine advances—medications that alleviate symptoms, interventions that reduce distress. But it has also produced a persistent gap. Patients get better neurochemically while remaining existentially empty. The field has become expert at treating biology without addressing meaning.

The Neuro-Existential Architecture System proposes a reframing. The fundamental question is not "What is wrong with the brain?" but "What has been destabilized in the hierarchical organization through which meaning is generated and maintained?" This question unifies neurobiology and existential philosophy. It explains why Frankl's observation—that meaning predicts survival—is not mystical but thermodynamic. It provides a scientific language for why "symptom remission" is not equivalent to healing.

The NEAS is speculative and incomplete. It will be challenged, modified, and refuted in parts. Some of its mechanisms will prove incorrect; others will require substantial revision. This is the normal process of scientific development. But by integrating five previously separate theoretical traditions, by grounding existential necessity in neurobiological mechanism, and by generating falsifiable predictions, the NEAS opens a conceptual space that contemporary psychiatry desperately needs.

If psychiatry is to advance beyond symptom management toward genuine healing, it must become a science of meaning. The NEAS is a first step toward that transformation. It suggests that meaning is not a luxury or a philosophical abstraction. Meaning is the thermodynamic necessity through which hierarchical organization maintains coherence. Meaning is written into the architecture of the human brain.

5. Disclosure For Use of Artificial Intelligence

In the preparation of this manuscript, artificial intelligence (AI) technology was used to assist with the creation of selected manuscript components, specifically the abstract, public significance statement, tables, and figures.

All AI-generated content was thoroughly reviewed and approved by the author, who takes full responsibility for the accuracy, originality, and integrity of all material presented. The author independently verified all factual claims, citations, and content to ensure compliance with academic standards and publication guidelines.

This use of AI aligns with established best practices and ethical guidelines for the application of generative AI in scientific research and publishing, including standards set by the International Committee of Medical Journal Editors (ICMJE), the American Association for the Advancement of Science (AAAS), and leading academic journals.

The author retains full intellectual authorship and accountability for this manuscript.

Public Significance Statement: This research bridges neuroscience and existential philosophy to explain why meaning matters for mental health. We propose that meaning is not a luxury but a fundamental organizing principle of the brain. When meaning is lost—through trauma or existential crisis—the entire brain destabilizes. By grounding meaning in neurobiology, we explain why feeling that life is worthwhile is essential to healing, and why psychiatry must address meaning, not just symptoms.

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References

Bastos, A. M., Usrey, W. M., Adams, R. A., Mangun, G. R., Fries, P., & Friston, K. J. (2012). Canonical microcircuits for predictive coding. *Neuron*, *76*(4), 695–711. https://doi.org/10.1016/j.neuron.2012.10.038

Beckers, T., & Kindt, M. (2017). Memory Reconsolidation Interference as an Emerging Treatment for Emotional Disorders: Strengths, Limitations, Challenges, and Opportunities. *Annual review of clinical psychology*, *13*, 99–121. https://doi.org/10.1146/annurev-clinpsy-032816-045209

Beggs, J. M., & Plenz, D. (2003). Neuronal avalanches in neocortical circuits. *The Journal of Neuroscience*, *23*(35), 11167–11177. https://doi.org/10.1523/JNEUROSCI.23-35-11167.2003

Bollen, K. A. (1989). *Structural equations with latent variables*. John Wiley & Sons.

Chialvo, D. R. (2010). Emergent complex neural dynamics. *Nature Physics*, *6*(10), 744–750. https://doi.org/10.1038/nphys1803

Crumbaugh, J. S., & Maholick, L. T. (1964). An experimental study in existentialism: The psychometric approach to Frankl's concept of noogenic neurosis. *Journal of Clinical Psychology*, *20*(2), 200–207. https://doi.org/10.1002/1097-4679(196404)20:2<200::AID-JCLP2270200203>3.0.CO;2-U

Ecker, B., Ticic, R., & Hulley, L. (2022). *Unlocking the emotional brain: Eliminating symptoms at their source*. Routledge.

Frankl, V. E. (1992). *Man's search for meaning* (Rev. ed.). Beacon Press Books. (Original work published 1946)

Friston, K. J. (2010). The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience*, *11*(2), 127–138. https://doi.org/10.1038/nrn2787

Geller, S. M., & Porges, S. W. (2014). Therapeutic presence: Neurophysiological mechanisms mediating feeling safe in therapeutic relationships. *Journal of Psychotherapy Integration*, *24*(3), 178–192. https://doi.org/10.1037/a0037511

Insel, T. R., & Cuthbert, B. N. (2015). Medicine. Brain disorders? Precisely. *Science (New York, N.Y.)*, *348*(6234), 499–500. https://doi.org/10.1126/science.aab2358

Jayawickreme, E., Infurna, F. J., Alajak, K., Blackie, L. E. R., Chopik, W. J., Chung, J. M., Dorfman, A., Fleeson, W., Forgeard, M. J. C., Frazier, P., Furr, R. M., Grossmann, I., Heller, A. S., Laceulle, O. M., Lucas, R. E., Luhmann, M., Luong, G., Meijer, L., McLean, K. C., Park, C. L., Zonneveld, R. (2021). Post-traumatic growth as positive personality change: Challenges, opportunities, and recommendations. *Journal of personality*, *89*(1), 145–165. https://doi.org/10.1111/jopy.12591

Kirmayer L. J. (2024). Unpacking "the social": a cultural-ecosocial systems approach. *Social psychiatry and psychiatric epidemiology*, *59*(3), 567–569. https://doi.org/10.1007/s00127-024-02625-1

Kredlow, M.A., Fenster, R. J., Laurent, E. S., Ressler, K. J., & Phelps, E. A. (2022). Prefrontal cortex, amygdala, and threat processing: implications for PTSD. *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*, *47*(1), 247–259. https://doi.org/10.1038/s41386-021-01155-7

Lee, J. L. C. (2009). Reconsolidation: Maintaining memory relevance. *Trends in Neurosciences*, *32*(8), 413–420. https://doi.org/10.1016/j.tins.2009.05.002

Leidig, G. (2025). The Neuro-Existential Architecture System (NEAS): A Predictive Processing Framework for Meaning, Criticality, and the Spiritual Master Prior. Preprints.

https://doi.org/10.20944/preprints202512.0955.v1

Martela, F., & Steger, M. F. (2016). The three meanings of meaning in life: Distinguishing coherence, purpose, and significance. *The Journal of Positive Psychology*, *11*(5), 531–545. https://doi.org/10.1080/17439760.2015.1137623

May, R. (1953). *Man's search for himself*. W.W. Norton & Company.

Melloni, L., Molina, C., Pena, M., Torres, D., Singer, W., & Rodriguez, E. (2007). Synchronization of neural activity across cortical areas correlates with conscious perception. *The Journal of Neuroscience*, *27*(11), 2858–2865. https://doi.org/10.1523/JNEUROSCI.4623-06.2007

Northoff, G. (2018). *The spontaneous brain: From the mind-body to the world-brain problem*. MIT Press.

Northoff, G., Wainio-Theberge, S., & Evers, K. (2020). Spatiotemporal neuroscience - what is it and why we need it. *Physics of life reviews*, *33*, 78–87. https://doi.org/10.1016/j.plrev.2020.06.005

Northoff, G., & Huang, Z. (2017). How do the brain's time and space mediate consciousness and its different dimensions? Temporo-spatial theory of consciousness (TTC). *Neuroscience and biobehavioral reviews*, *80*, 630–645. https://doi.org/10.1016/j.neubiorev.2017.07.013

Schachner, D. A., & Boals, A. (2015). Posttraumatic growth and facets of personality: The roles of openness and neuroticism. *Personality and Individual Differences*, *86*, 314–319. https://doi.org/10.1016/j.paid.2015.06.041

Seligman, R., & Kirmayer, L. J. (2008). Dissociative experience and cultural neuroscience: narrative, metaphor and mechanism. *Culture, medicine and psychiatry*, *32*(1), 31–64. https://doi.org/10.1007/s11013-007-9077-8

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

Szasz, T. S. (2010). *The myth of mental illness: Foundations of a theory of personal conduct* (Rev. ed.). Harper Perennial. (Original work published 1961)

Tedeschi, R. G., & Calhoun, L. G. (2004). TARGET ARTICLE: "Posttraumatic Growth: Conceptual Foundations and Empirical Evidence."*Psychological Inquiry*, *15*(1), 1–18. https://doi.org/10.1207/s15327965pli1501_01

Toker, D., Sommer, F. T., & D'Esposito, M. (2022). Consciousness is supported by near-critical slow cortical electrodynamics. *Proceedings of the National Academy of Sciences*, *119*(7), e2024455119. https://doi.org/10.1073/pnas.2024455119

Tucker, D. M., & Luu, P. (2021). Motive control of unconscious inference: The limbic base of adaptive Bayes. Neuroscience & Biobehavioral Reviews, 128, 328–345. https://doi.org/10.1016/j.neubiorev.2021.05.029

Tucker, D. M., Luu, P., & Friston, K. J. (2025). The Criticality of Consciousness: Excitatory-Inhibitory Balance and Dual Memory Systems in Active Inference. *Entropy (Basel, Switzerland)*, *27*(8), 829. https://doi.org/10.3390/e27080829

Turecki, G., & Brent, D. A. (2016). Suicide and suicidal behaviour. *Lancet (London, England)*, *387*(10024), 1227–1239. https://doi.org/10.1016/S0140-6736(15)00234-2

van der Kolk, B. (2014). *The body keeps the score: Brain, mind, and body in the healing of trauma*. Viking.

Wolfers, T., Beckmann, C. F., Hoogman, M., Buitelaar, J. K., Franke, B., & Marquand, A. F. (2020). Individual differences *v.* the average patient: mapping the heterogeneity in ADHD using normative models. *Psychological medicine*, *50*(2), 314–323. https://doi.org/10.1017/S0033291719000084

Yalom, I. D. (2008). *Staring at the sun: Overcoming the terror of death*. Jossey-Bass.