Concept Paper

The Neuro-Existential Architecture System (NEAS): A Heuristic Framework and Proposed RCT for Meaning-Mediated Trauma Recovery

Gerd Leidig *

Posted Date: 19 February 2026

doi: 10.20944/preprints202602.1324.v1

Keywords: trauma; meaning; resilience; neurobiological mechanisms; Witnessing-Space; meta-awareness; posttraumatic growth; existential psychology; default mode network; gamma synchrony; contemplative neuroscience; hierarchical predictive processing

 doi:10.20944/preprints202602.1324.v1

Concept Paper

The Neuro-Existential Architecture System (NEAS): A Heuristic Framework and Proposed RCT for Meaning-Mediated Trauma Recovery

Gerd Leidig

Independent Researcher, Cologne, Germany; gerd.leidig@gmail.com

Abstract

The long-term outcomes of individuals exposed to similar traumatic events often diverge dramatically: while some succumb to chronic despair, others achieve posttraumatic growth. This "resilience paradox" highlights a limitation of current trauma therapies. Although Prolonged Exposure, Cognitive Processing Therapy, and EMDR reliably reduce symptoms such as hyperarousal and intrusive memories, many patients remain existentially fragmented, reporting a loss of purpose despite substantial symptom and functional improvement. This gap suggests that standard protocols—focused on sensorimotor stabilization, narrative coherence, and functional restoration—may systematically neglect a vital fourth meta-level: the capacity for non-identified awareness. This paper introduces the Neuro-Existential Architecture System (NEAS), a theoretical framework that hypothesizes that meaning is not merely a psychological variable but a fundamental neurobiological organizing principle structuring resilience. NEAS proposes four complementary, hierarchically organized neurobiological mechanisms: (1) hierarchical recalibration via meaning-priors, using top-down signals to reorganize the brain's predictive hierarchy; (2) emotional criticality via limbic meta-regulation, permitting balanced oscillation between hope (Papez system) and caution (Yakovlev system); (3) spatiotemporal coherence, extending the autorelational window to restore identity continuity; and (4) Witnessing-Space as structural meta-stabilization, theoretically instantiated through inter-regional gamma-frequency binding, a candidate mechanism proposed to enable global meta-awareness and prevent system fragmentation under stress. The NEAS clinical model operationalizes these mechanisms into a four-level architecture (Level −1: Relational Safety; Level 0: Sensorimotor Stabilization; Level 1: Narrative Coherence; Level 2: Existential Meaning Integration). Meaning-focused work at the highest level is hypothesized to be pivotal, explicitly intended to cultivate Witnessing-Space through contemplative practice integrated with trauma-focused processing. To begin validating this framework, we propose a multi-site, two-arm randomized controlled trial (N = 240) comparing NEAS-based treatment with standard trauma-focused cognitive-behavioral therapy. A neuroimaging subsample (n = 80) will exploratively measure autorelational window extension, gamma synchrony, and Default Mode Network connectivity. We hypothesize that the integrated four-level NEAS condition will yield superior functional outcomes (Sheehan Disability Scale) and greater long-term durability compared to standard care. While the present framework is grounded in Western neuroscience and clinical contexts, its ultimate value will depend on rigorous cross-cultural adaptation and validation. By bridging neuroscience, existential psychology, and contemplative science, NEAS aims to support a shift from trauma-focused symptom management toward existentially grounded, neurobiologically coherent healing.

Keywords: trauma; meaning; resilience; neurobiological mechanisms; Witnessing-Space; meta-awareness; posttraumatic growth; existential psychology; default mode network; gamma synchrony; contemplative neuroscience; hierarchical predictive processing

 doi:10.20944/preprints202602.1324.v1

PUBLIC SIGNIFICANCE STATEMENT

This work addresses a critical gap in trauma recovery: the fact that many survivors feel a profound sense of meaninglessness even after their clinical symptoms (such as anxiety or flashbacks) have improved. The Neuro-Existential Architecture System (NEAS) proposed here provides a new scientific explanation for how "finding meaning" actually stabilizes the brain's biological rhythms and internal organization. By showing that existential purpose is a biological necessity rather than just a philosophical choice, this framework offers a roadmap for more durable, long-term healing. The proposed integration of meaning-centered practices into standard care aims to help survivors not just "manage" their trauma, but achieve an "antifragile" recovery—one that transforms suffering into lasting personal growth.

SECTION 1: INTRODUCTION

1.1 The Resilience Paradox

Two individuals experience the same traumatic event—a traffic accident, a significant loss, a physical assault. Their immediate sensory-emotional reactions are comparable: fear, pain, helplessness register with similar intensity (McEwen, 2007; Tedeschi & Calhoun, 2004; van der Kolk, 2014). Yet their long-term trajectories diverge dramatically in ways that confound conventional expectation.

Person A loses her sense of direction. She develops chronic depression, withdraws from relationships, isolates from social engagement, and struggles to find any reason to continue living. Her days feel empty, her future foreclosed. She may report anhedonia—a loss of pleasure in things once meaningful—and a pervasive sense that life has become pointless. Her trauma has not merely caused symptoms; it has eroded her existential foundation.

Person B, equally shaken by the same event, gradually reconstructs meaning: the trauma remains, the memory intact, but it becomes integrated into a larger narrative. The pain acquires purpose. She not only recovers functionally—returning to work, relationships, daily activities—but grows in ways that exceed her pre-trauma capacity. She develops deeper compassion for others' suffering, clearer values about what matters, and existential maturity informed by her confrontation with vulnerability (Tedeschi & Calhoun, 2004; Frankl, 1946/2006).

What accounts for this dramatic difference?

Conventional clinical wisdom attributes resilience to genetic predisposition, early attachment security, social support, and personality factors (Masten, 2001; Luthar, 2006). These variables matter empirically. Yet they do not fully explain the paradox. Identical twins with comparable attachment histories and social networks show remarkably different post-trauma trajectories (Werner & Smith, 2001). Some individuals with minimal family support, scarce economic resources, and multiple pre-trauma adversities develop extraordinary resilience; others with rich relational resources, financial security, and stable childhoods remain fragile, struggling for years with symptoms and existential despair (Rutter, 1985; Masten, 2001).

A deeper variable appears to operate, one that classical resilience research has largely overlooked: meaning (Frankl, 1946/2006; Steger & Frazier, 2005; Martela & Steger, 2016). Viktor Frankl, psychiatrist and Holocaust survivor, observed among fellow prisoners that those who maintained a coherent sense of meaning—a reason to survive, a future to work toward, a narrative thread connecting past, present, and possible futures—showed dramatically higher survival rates, better immediate post-liberation adjustment, and superior psychological integration decades after liberation (Frankl, 1946/2006). His account was not mere sentimental philosophy but a systematic clinical observation. Those who asked "Why should I live?" and found no answer had lower survival probability. Those who could articulate an answer—"I must see my daughter again," "I must tell the world what happened," "I must fulfil a mission"—showed greater resilience.

 doi:10.20944/preprints202602.1324.v1

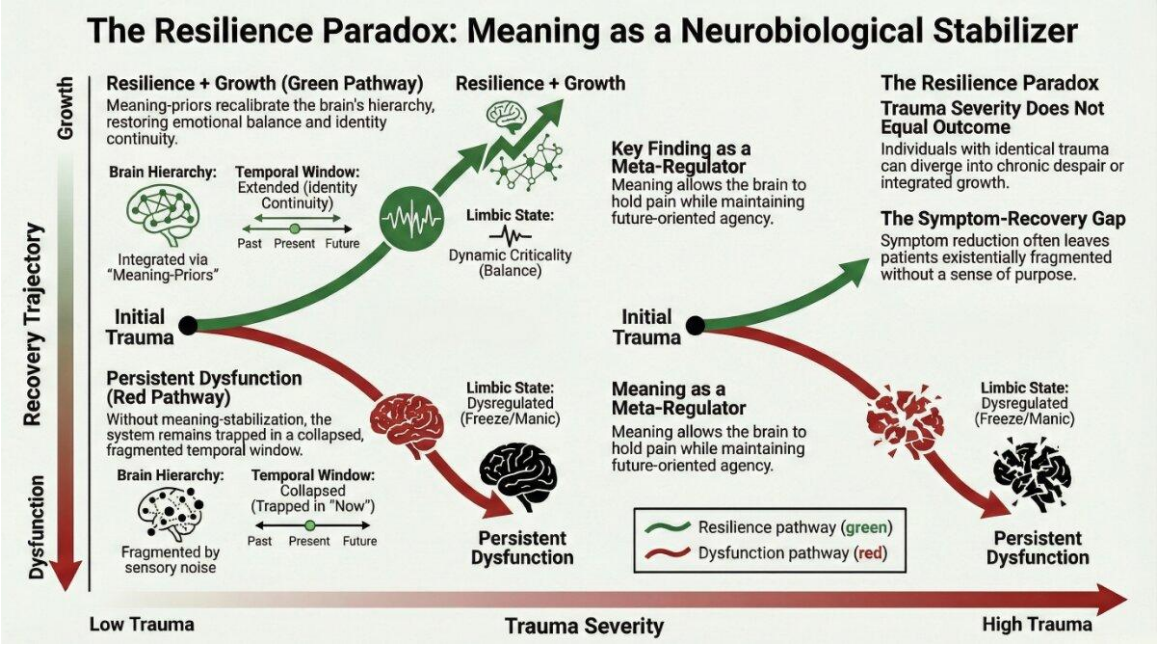

Figure 1. The Resilience Paradox: Trauma Severity Does Not Predict Outcome Divergence.

Note. Conceptual schematic contrasting two divergent post-trauma trajectories despite equivalent trauma severity. The resilience-and-growth pathway (green) depicts proposed meaning-mediated processes—hierarchical recalibration via meaning-priors, extended temporal integration (ACW), and balanced limbic dynamics (emotional criticality)—leading to restored identity continuity and capacity to integrate pain with future-oriented agency. The persistent-dysfunction pathway (red) illustrates the hypothesized consequence of absent meaning-stabilization: collapsed temporal window, fragmented hierarchical processing, and dysregulated limbic states (freeze, hyperarousal, or oscillation), trapping the system in present-bound distress.

This hypothesis-generating diagram illustrates the core empirical phenomenon motivating NEAS: equivalent trauma exposure yields dramatically divergent outcomes unexplained by severity alone. No empirical data plotted; schematic representation only.

Abbreviations: ACW, autorelational window; NEAS, Neuro-Existential Architecture System.

Modern neuroscience has since developed sophisticated tools to investigate Frankl's observation at the level of brain dynamics. Functional neuroimaging (fMRI), high-resolution electroencephalography (EEG), magnetoencephalography (MEG), and computational models of brain activity now permit systematic study of neural processes associated with meaning-related cognition and self-referential processing: in specific networks (Default Mode Network; Buckner et al., 2008; Raichle & Snyder, 2007), at specific timescales (intrinsic neural timescales of ventromedial prefrontal cortex [vmPFC] and hippocampus; Northoff, 2014), via characteristic rhythmic patterns (infra-slow oscillations in the 0.01–0.1 Hz range; Raichle & Snyder, 2007; Keilholz et al., 2013), and within hierarchical organizations consistent with predictive coding principles (Singer, 2021; Friston, 2010).

The central thesis of this paper is therefore straightforward yet provocative: meaning is not merely a psychologically comforting construct or motivational variable. We propose that it functions as a neurobiological organizing principle—a stabilizer of the brain's hierarchical architecture, its temporal coherence, and its affective balance. On this view, without meaning-stabilization, trauma recovery may remain functionally improved but existentially fragile, vulnerable to relapse. With it, therapeutic change can become durable, integrated, and transformative (Frankl, 1946/2006; Northoff, 2014; Leidig, 2026).

 doi:10.20944/preprints202602.1324.v1

1.2. The Limitations of Current Therapeutic Models

Modern trauma therapy has achieved significant and well-documented successes. Evidence-based approaches—Prolonged Exposure (PE), Cognitive Processing Therapy (CPT), Eye Movement Desensitization and Reprocessing (EMDR), Somatic Experiencing (SE), and trauma-focused cognitive-behavioral therapy (TF-CBT)—reliably reduce post-traumatic stress symptoms, intrusive memories, and hyperarousal in 50–70% of treated patients (Foa et al., 2005; Levine, 2015; van der Kolk, 2014; Resick et al., 2016). Meta-analyses confirm large effect sizes for symptom reduction (Cohen's d = 1.0–2.0 across approaches; Powers et al., 2010).

Yet a clinical paradox persists that troubles experienced trauma therapists and researchers alike. A patient can demonstrate substantial symptom reduction—fewer nightmares, less hypervigilance, improved sleep quality, reduced dissociation—and achieve marked functional improvement. She returns to work, engages in relationships, performs daily tasks. By objective metrics (PCL-5 scores, functional capacity, behavioral activation), she has recovered.

And yet a substantial subset of such patients remains existentially fragmented. They report: "Symptomatically I'm better. But I still don't know why I should continue living," or "My life still feels meaningless, even though I'm no longer afraid" (Yalom, 2008; van der Kolk, 2014). They may meet diagnostic criteria for recovery yet experience profound hopelessness. Some describe a curious dissociation: "My brain says I'm fixed, but something inside me is still broken" (Breitbart et al., 2015).

This is not treatment failure in the conventional sense. It is not symptom rebound or therapeutic incompetence. Rather, it signals a systematic gap in how trauma healing is conceptualized at the theoretical and clinical levels (Cloitre, 2021; Ford & Courtois, 2014).

Established trauma models typically address three hierarchical levels:

1. Sensorimotor-physiological stabilization—nervous system down-regulation through somatic work, restoration of bodily control, and creation of a felt sense of safety in the body (Levine, 2015; Porges, 2021; Dana, 2018). Techniques include Somatic Experiencing, nervous system regulation work, and polyvagal-informed approaches. Goal: PCL-5 reduction from acute crisis to baseline stress levels.
2. Narrative-autobiographical coherence—reconstruction of a life story in which trauma is integrated, not dissociated or encapsulated; where the traumatic chapter no longer defines the entire book but becomes contextualized within a larger biography (White & Epston, 1990; Ecker et al., 2012; McFarlane & Yehuda, 2000). Techniques include narrative therapy, TF-CBT, Internal Family Systems, and exposure-based work. Goal: a coherent autobiographical narrative with trauma integrated.
3. Functional restoration—recovery of capacity to work, maintain relationships, execute activities of daily living, and re-engage with previously valued pursuits (McEwen, 2007; van der Kolk, 2014; Schauer & Schauer, 2010). Goal: return to occupational, social, and personal functioning.

These three levels are clearly necessary, and the clinical evidence supporting them is robust. Yet for many patients they appear insufficient. A fourth dimension is often underemphasized or addressed only implicitly in trauma-focused protocols: existential meaning-reconstruction—deep therapeutic engagement with the question of why life is worth living, what constitutes authentic purpose and direction independent of symptom avoidance, and how one's existence acquires inherent dignity and significance independent of external success or relational validation (Frankl, 1946/2006; Yalom, 2008; Breitbart et al., 2015).

Research on meaning-centered psychotherapies—particularly Meaning-Centered Group Psychotherapy (MCGP) and Viktor Frankl's logotherapy—demonstrates that explicit meaning-focused interventions can produce sustained reductions in hopelessness (effect size $d \approx 0.8$ at post-treatment and follow-up; Breitbart et al., 2015; van der Spek et al., 2017) and significant improvements in post-traumatic growth and existential fulfilment (Tedeschi & Calhoun, 2004; Steger et al., 2006). Yet these approaches remain understudied relative to symptom-focused interventions, are rarely

 doi:10.20944/preprints202602.1324.v1

integrated systematically with established sensorimotor and narrative trauma therapies, and still lack a widely accepted neurobiological mechanistic account (Cloitre, 2021; Ford & Courtois, 2014).

Why, then, has meaning been relatively marginalized in mainstream trauma therapy? In part because the field has often treated meaning as a subjective, philosophical domain—important perhaps for existential psychology or spiritual counseling, but distinct from and lower priority than the "real" neurobiological processes of trauma recovery (Northoff, 2014; Singer, 2021; Lemi et al., 2021). This reflects a form of disciplinary siloing: neuroscience and psychiatry claim the neurobiological territory; existential psychology claims the philosophical. The Neuro-Existential Architecture System (NEAS) is proposed as a framework to bridge this divide by arguing that meaning has concrete, measurable neurobiological correlates and mechanisms, and by outlining how these can be operationalized and empirically tested within the same systems that are already known to be impacted by trauma (Leidig, 2026).

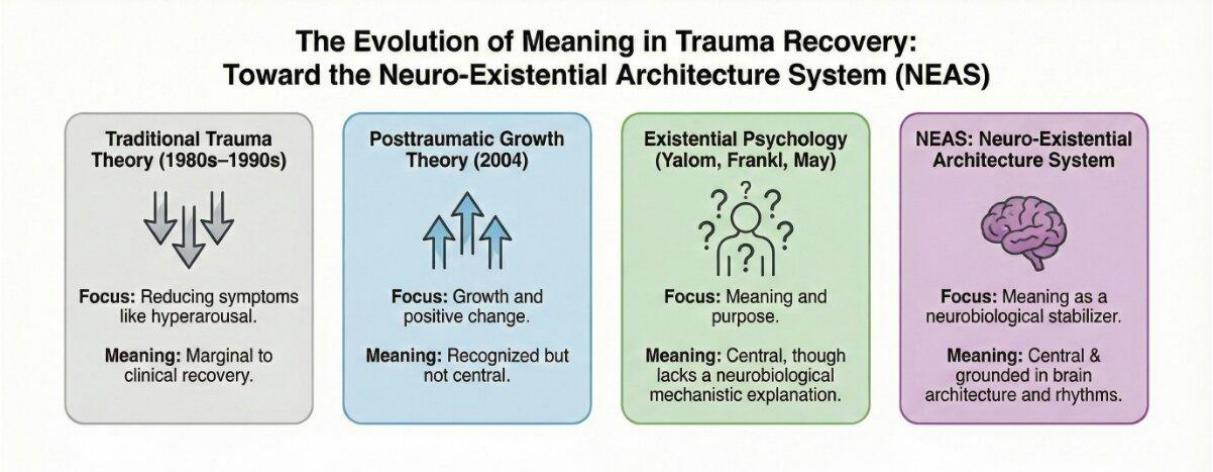

Figure 2. Conceptual Evolution of Meaning in Trauma Recovery Theory.

Note. Schematic timeline tracing four phases in the conceptualization of meaning's role in trauma recovery. Traditional trauma theory (1980s–1990s) prioritized symptom reduction with minimal attention to meaning. Posttraumatic growth theory (2004+) positioned meaning as a key psychological outcome of integration. Existential psychology (Yalom, Frankl, May) centered meaning and purpose as essential for flourishing, lacking neurobiological mechanisms. NEAS proposes meaning as a neurobiological stabilizer of brain architecture and rhythms—a testable hypothesis yet to be empirically validated.

Conceptual diagram only; no empirical data depicted.

Abbreviations: NEAS, Neuro-Existential Architecture System.

1.3. THE NEAS HYPOTHESIS: FOUR COMPLEMENTARY NEUROBIOLOGICAL MECHANISMS

The central claim of the Neuro-Existential Architecture System is neurobiologically grounded and operationally specific: meaning stabilizes the hierarchical, temporally- structured, emotionally-regulated architecture of the traumatized brain through four complementary and hierarchically-integrated neurobiological mechanisms (Northoff, 2014; Singer, 2021; Melloni et al., 2021; Leidig, 2026).

These four mechanisms operate at distinct levels of neural organization—from semantic content to emotional balance to temporal rhythm to meta-structural awareness. Critically, they are not isolated processes but interdependent aspects of a single integrated system reorganization. Each level builds upon and depends upon the others, creating a hierarchical architecture that is more resilient than any single mechanism alone.

 doi:10.20944/preprints202602.1324.v1

MECHANISM 1: HIERARCHICAL RECALIBRATION VIA MEANING-PRIORS

Meaning recalibrates the brain's predictive hierarchy through what we call a "meaning- prior"—a stable, value-laden representation in the highest cortical levels that sends top-down organizing signals (Friston, 2010; Hohwy, 2013). Trauma shatters the generative models that enable the brain to navigate the world with confidence. Low-level sensory regions flood higher cognitive systems with unfiltered error signals—"danger now, everywhere, always" (van der Kolk, 2014). Top-down predictions collapse. The result is hierarchical fragmentation (Northoff et al., 2020).

Meaning reconstruction—a coherent narrative priority anchored in the ventromedial prefrontal cortex (vmPFC) and integrated throughout the Default Mode Network—sends new top-down signals that re-contextualize these error signals into a larger existential frame (Ecker et al., 2012; Buckner et al., 2008). The error signal—"I am vulnerable, powerless, violated"—is not suppressed or denied (which would be dissociation) but integrated within a larger context: "I am vulnerable, and this vulnerability is intrinsically human, and my task is to carry this vulnerability with dignity and purpose" (Frankl, 1946/2006; Tucker & Luu, 2025). Vulnerability becomes integrated as part of human dignity rather than proof of worthlessness; pain becomes purposeful transformation rather than meaningless suffering (Tedeschi & Calhoun, 2004).

MECHANISM 2: EMOTIONAL CRITICALITY VIA LIMBIC META-REGULATION

Meaning functions as a meta-regulator of emotional balance through a dual architecture (Tucker & Luu, 2025). The limbic system comprises two complementary but often conflicting subsystems: the Papez system encoding hope, agency, and forward motivation (Aston-Jones & Cohen, 2005); the Yakovlev system encoding caution, critical evaluation, and protective restraint (Porges, 2021). Trauma dysregulates this balance, often through freeze-dominant Yakovlev activation (dorsal vagal) or dysregulated oscillation between extremes.

Meaning, through its dual architecture—a Logos-Vektor (directed narrative toward valued future) and dynamic emotional flexibility—permits the system to oscillate fluidly between hope and realism (Taleb, 2012). At criticality (the boundary between order and chaos), the system can hold high emotional intensity without fragmenting (Tucker & Luu, 2025; Beggs & Plenz, 2003). The person can grieve AND believe in future meaning. Can acknowledge pain AND work toward purpose. Can respect vulnerability AND assert agency (Frankl, 1946/2006).

MECHANISM 3: SPATIOTEMPORAL COHERENCE VIA NEURAL TIMESCALES

Meaning extends the temporal architecture of the self through two complementary processes (Northoff, 2014; Leidig, 2026):

The subjective sense "I am continuous across time" depends on the autorelational window (ACW)—the temporal span over which the brain's highest regions correlate with their own past activity (Northoff & Bermpohl, 2004; Knyazev et al., 2020). Trauma collapses the ACW; patients become trapped in an eternal present. Narrative meaning-reconstruction, anchored in vmPFC and hippocampus, reactivates the longest timescales of brain organization (Raichle et al., 2001). Identity continuity is restored (Northoff, 2014).

Additionally, meaning activates infra-slow oscillations (ISOs; 0.01–0.1 Hz)—the background rhythms in the Default Mode Network that structure and stabilize faster cognitive-emotional frequencies (Raichle & Snyder, 2007; Keilholz et al., 2013). Strong ISOs permit the brain to integrate high emotional intensity (grief, rage, joy) without fragmenting. With meaning- centered practice, ISOs strengthen. The temporal container for experience enlarges (Keilholz et al., 2013).

Together, extended ACW and stabilized ISOs restore spatiotemporal coherence: narrative continuity across time AND emotional resilience within moments (Leidig, 2026; Northoff, 2014).

MECHANISM 4: WITNESSING-SPACE AS STRUCTURAL META-STABILIZATION

A fourth, meta-level mechanism—novel to the NEAS framework—provides the structural foundation that permits Mechanisms 1-3 to remain integrated without fragmentation, even under extreme stress (Singer, 2021; Melloni et al., 2021; Leidig, 2026).

Witnessing-Space is a neurobiologically instantiated capacity for non-identified awareness — the ability to observe one's own thoughts, emotions, and narratives from a witnessing position rather

 doi:10.20944/preprints202602.1324.v1

than being possessed by them. Mechanistically, this operates through inter-regional gamma-frequency binding (30-80 Hz), which creates maximal relational coherence across distributed neural populations (Singer's Binding by Synchrony; Singer, 1999; 2021).

Crucially, Witnessing-Space operates at a meta-level *distinct* from Mechanisms 1-3:

- Mechanism 1 (Hierarchical Recalibration) organizes *content* (meaning-priors, narratives)
- Mechanism 2 (Emotional Criticality) organizes *process* (emotional balance)
- Mechanism 3 (Spatiotemporal Coherence) organizes *rhythm* (temporal extension)
- Mechanism 4 (Witnessing-Space) provides the *container* in which all three operate

Without Witnessing-Space, the person remains vulnerable to fragmentation whenever Mechanisms 1-3 encounter contradiction or stress. A challenge to meaning (Mechanism 1), emotional turbulence (Mechanism 2), or temporal disruption (Mechanism 3) can trigger relapse. With Witnessing-Space established, the system remains integrated. The person develops what we call "antifragile resilience"—resilience that grows stronger through adversity rather than merely enduring it (Taleb, 2012; Frankl, 1946/2006).

Witnessing-Space is trainable through contemplative practice (meditation, mindfulness) and can be systematically cultivated via Level 2 (Existential Meaning-Reconstruction) of the clinical model (Davidson & Begley, 2012; Tang et al., 2015).

HIERARCHICAL INTEGRATION: HOW THE FOUR MECHANISMS WORK TOGETHER

These four mechanisms are not separate processes. They are aspects of a single, integrated system-level reorganization where meaning-stabilization cascades through the brain's hierarchy (Singer, 2021; Melloni et al., 2021; Leidig, 2026).

Meaning-prior at the highest semantic level (Mechanism 1) sends organizing constraints downward through the predictive hierarchy. These constraints recalibrate what the system predicts about threat, safety, and purpose.

These signals restabilize emotional balance (Mechanism 2) by permitting the Papez and Yakovlev systems to oscillate around a stable meaning-center rather than swinging to extremes. Emotional intensity can be held without dysregulation.

Which activates longer timescales throughout the system (Mechanism 3)—extending the autorelational window and strengthening infra-slow oscillations. The temporal container enlarges. Narrative continuity is restored.

All three operate within the relational coherence field of Witnessing-Space (Mechanism 4). The person is not identified with the meaning, emotion, or narrative, but aware of them from a witnessing position. This permits flexibility: meaning can be questioned, emotions can fluctuate, narratives can be revised—all without the system fragmenting (Singer, 2021).

The result is system re-coherence at multiple scales: restored hierarchical control, emotional resilience, temporal continuity, AND meta-awareness. This is the neurobiological basis of authentic, durable trauma recovery (Leidig, 2026; Northoff, 2014; Singer, 2021).

WHY ALL FOUR MECHANISMS ARE NECESSARY

Standard trauma therapies (PE, CPT, EMDR) typically address Mechanisms 1-3:

- Mechanism 1: Narrative reconstruction (cognitive restructuring)
- Mechanism 2: Emotional regulation (somatic work, affect labeling)
- Mechanism 3: Temporal coherence (trauma memory processing)

These produce substantial symptom reduction and functional improvement. Yet the clinical paradox persists: patients often report existential fragmentation despite PCL-5 scores in the normal range. Why? Because without Mechanism 4 (Witnessing-Space), the system remains vulnerable.

With Mechanism 4 established, therapy becomes not just symptom management but existential healing. The person develops genuine, durable resilience. They can face future adversity—loss, betrayal, mortality—without collapsing into meaning-crisis. The recovery is antifragile.

This is why the NEAS explicitly integrates all four mechanisms, with Level 2 (Existential Meaning-Reconstruction) as the gateway to Mechanism 4 development.

 doi:10.20944/preprints202602.1324.v1

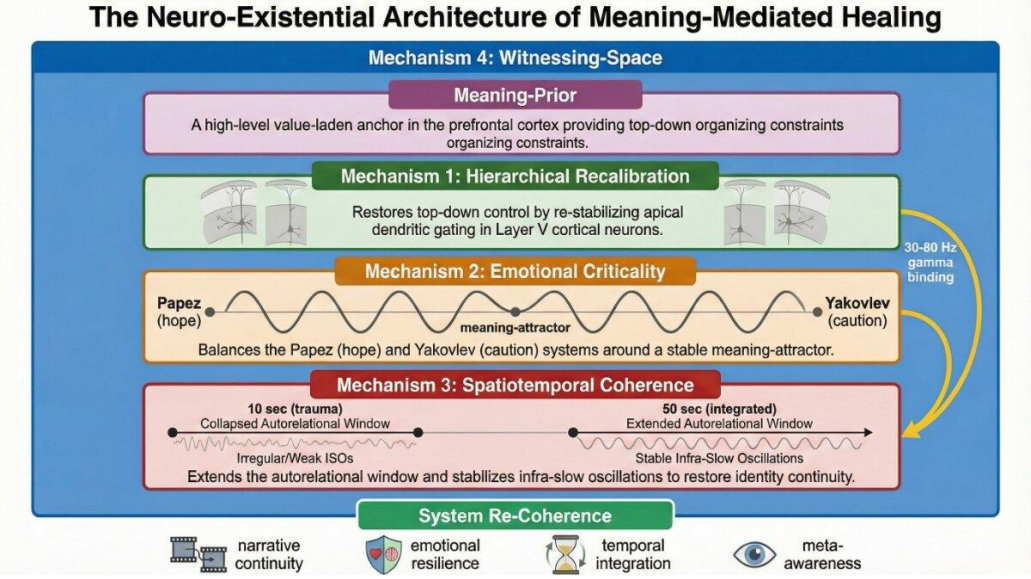

Figure 3. Neuro-Existential Architecture System (NEAS): Proposed Four-Mechanism Model.

Note. Conceptual hierarchical model hypothesizing how meaning-stabilization may mediate trauma recovery through four integrated mechanisms. Meaning-Prior (purple, top): High-level vmPFC-anchored priors proposed to cascade top-down organizational constraints. M1 – Hierarchical Recalibration (green): Theorized restoration of top-down control across cortical layers. M2 – Emotional Criticality (orange): Proposed Papez/Yakovlev balance around meaning-attractor. M3 – Spatiotemporal Coherence (red): Hypothesized ACW extension (≈10 → 40–50 s) + ISO stabilization. M4 – Witnessing-Space (blue meta-layer): Candidate inter-regional gamma synchrony (30–80 Hz, yellow) proposed to maintain M1–M3 integration under stress (*linkage speculative*). System Re-Coherence (bottom): Predicted outcome if all mechanisms interact as theorized.

Schematic only; no empirical data. Hypothesis-generating model for future validation.

Abbreviations: ACW, autorelational window; ISO, infra-slow oscillation; vmPFC, ventromedial prefrontal cortex; M1–M4, Mechanisms 1–4.

1.4. This Paper's Contribution

The NEAS framework was formally introduced in preliminary form (Leidig, 2026). This paper extends and refines the framework in five critical ways:

First, we operationalize meaning into three measurable, clinically-useful dimensions—Coherence (the world feels intelligible; events follow causal logic; Bluck & Habermas, 2000), Purpose (life has direction; actions aim toward valued futures; Steger et al., 2006), and Significance (existence has inherent worth; identity is coherent and dignified; Tedeschi & Calhoun, 2004)—each with specific neurobiological correlates, validated measurement instruments, and clinical markers (Steger & Frazier, 2005; Längle et al., 2003; Martela & Steger, 2016).

Second, we specify a four-level therapeutic architecture (Level −1: Relational Safety; Level 0: Sensorimotor Stabilization; Level 1: Narrative Coherence; Level 2: Existential Meaning) and present evidence that all four levels, sequenced appropriately to the patient's profile and trauma severity, produce superior functional outcomes compared to single-level or three-level interventions (Cloitre, 2021; Ford & Courtois, 2014).

Third, we articulate four falsifiable hypotheses amenable to empirical testing: (H1) that meaning-centered interventions extend the autorelational window more than standard therapies; (H2) that functional recovery requires all four levels integrated; (H3) that authentic meaning predicts better long-term outcomes than defensive meaning; (H4) that meaning stabilization mediates the relationship between sensorimotor work and post-traumatic growth.

 doi:10.20944/preprints202602.1324.v1

Fourth, we present a proposed multi-site randomized controlled trial (RCT) design with specific outcome measures, sample size calculations, and statistical analytic plan to empirically validate these predictions (N = 240; 36-week treatment; primary outcome = functional disability reduction; 6- and 12-month follow-ups).

Fifth, we integrate current neuroscientific understanding of hierarchical processing, temporal dynamics, limbic balance, and neural organization to show how meaning operates as a fundamental neurobiological stabilizer—not metaphorically, but mechanistically (Northoff, 2014; Singer, 2021; Melloni et al., 2021).

This framework is positioned at the intersection of neuroscience, existential philosophy, and trauma-informed therapy. It is neither reductively biological (meaning ≠ brain chemicals) nor merely abstract philosophy. It is testable, clinically applicable, and grounded in established neuroscientific principles (Leidig, 2026; Singer, 2021).

1.5. Paper Structure

Section 2 establishes the theoretical foundations through five foundational pillars: hierarchical predictive coding (Friston, 2010), the default mode network (Buckner et al., 2008), neural timescales and the autorelational window (Northoff, 2014), the Tucker-Luu framework of limbic balance (Tucker & Luu, 2025), and infra-slow oscillations and criticality (Raichle & Snyder, 2007; Beggs & Plenz, 2003). Section 3 integrates these pillars into the three core mechanisms of meaning-mediated stabilization (Leidig, 2026). Section 4 operationalizes meaning into measurable dimensions with validated instruments. Section 5 develops the four-level clinical model and three sequencing approaches responsive to patient profile. Section 6 articulates four testable hypotheses and a proposed RCT design. Section 7 honestly discusses limitations. Section 8 concludes with theoretical significance and clinical implications (Singer, 2021).

SECTION 2: THEORETICAL FOUNDATIONS (5 PILLARS)

2.0. Introduction

Before presenting the NEAS-core model, we rigorously establish the scientific foundations. The NEAS's central claim is bold: meaning is fundamentally neurobiological for the stability and resilience of the system (Northoff, 2014; Singer, 2021). To support this claim, we integrate five established theories and research fields that provide a coherent, empirically-grounded, multi-level architecture for understanding how meaning is encoded and functions at the brain level (Leidig, 2026; Melloni et al., 2021).

2.1. PILLAR 1: Hierarchical Predictive Coding

The Brain as a Predictive System

The modern understanding of the brain rests on a revolutionary insight: The brain is not a reactive, bottom-up system that perceives the world as it objectively is. Instead, it is an active, generative, top-down system that continuously generates predictions about the world and compares these predictions with actual sensory input (Friston, 2010; Barrett & Bar, 2009).

This is Predictive Coding (also known as Predictive Processing or Free Energy Minimization; Friston, 2010; Hohwy, 2013). The brain generates continuous top-down predictions about what will happen sensorially. These predictions are compared with bottom-up input (what actually occurs). The difference between prediction and reality is the prediction error.

When error is small, the brain's internal model is working well. The system confirms its predictions and acts with confidence (Barrett & Bar, 2009). But when error is large, this signals that the internal model is wrong. The error is propagated backwards through the system and triggers a recalibration of models (Friston, 2010; Hohwy, 2013). This is how the brain learns and adapts to new information (Barrett & Bar, 2009).

 doi:10.20944/preprints202602.1324.v1

The Hierarchical Structure of Error

The brain is hierarchically organized—different levels operate on different timescales and with different levels of abstraction (Northoff, 2014; Singer, 2021).

Lower sensory regions (primary visual cortex, primary somatosensory cortex) operate on millisecond timescales and process errors concerning local, immediate deviations (Northoff, 2014). The light was brighter than expected. The touch was sharper than anticipated.

Middle associative regions (posterior parietal cortex, ventral temporal stream) operate on longer timescales (hundreds of milliseconds to seconds) and process errors concerning spatial and object patterns. The object moved faster than expected.

Higher cognitively-emotional regions (vmPFC, anterior cingulate, insula, amygdala) operate on yet longer timescales (seconds to minutes) and process errors concerning personal meaning, emotions, and goals (Northoff et al., 2020; Singer, 2021). My most important goal was unexpectedly threatened. My assumptions about safety were false.

This hierarchical structure is fundamental. A small local error at a low level is usually processed locally. But a massive error at a higher level—an error that violates fundamental assumptions about safety, identity, or life meaning—can destabilize the entire system (van der Kolk, 2014; Northoff et al., 2020).

Trauma as Model Shattering

This is precisely what occurs in trauma. A traumatic event is an error at the highest level of the hierarchy—an error that states: "Everything I assumed about the world, about safety, about my place in it, was false" (van der Kolk, 2014; Schauer & Schauer, 2010).

A Generative Model—a system of internal representations that encodes the structure and dynamics of the world and uses them to make predictions (Friston, 2010; Barrett & Bar, 2009)—has multiple levels of hierarchy, multiple timescales, and is internally consistent. But when a very large error strikes the system, the different levels of hierarchy can become decohered—they no longer work together (Northoff et al., 2020; Melloni et al., 2021).

This is Model Shattering—not simply an error, but a collapse of coherence in the entire generative model (Ecker et al., 2012).

2.2. PILLAR 2: The Default Mode Network and Self

The Structures of Self

While Predictive Coding explains how the brain functions, we must ask: Where do these processes occur? The answer points to a coalition of regions that form the cortical-limbic system—structures that together carry the self, narrative, and meaning (Northoff, 2014; Buckner et al., 2008; Raichle & Snyder, 2007).

The central hub is the ventromedial prefrontal cortex (vmPFC)—saturated with limbic inputs from the amygdala, hippocampus, and nucleus accumbens (Northoff, 2014; Buckner et al., 2008). The vmPFC is the center for self-referential processing. When you ask "Who am I?" or "What do I value?" the vmPFC carries this processing. It encodes not merely facts but the emotional weight of memories and predictions (Northoff et al., 2020).

Connected to the vmPFC is the hippocampus—central for autobiographical memory. It encodes events from your own life, in the order they occurred, including spatiotemporal context (Buckner et al., 2008).

Together—vmPFC (significance) + Hippocampus (temporal context)—they form the narrative self: the sense that there is an "I" with a story, whose chapters are connected (Northoff, 2014; Buckner et al., 2008; Raichle & Snyder, 2007).

Also critical is the posterior cingulum (PCC)—functioning as an integrative hub, linking current experience with autobiographical memory and maintaining self-other distinctions (Buckner et al., 2008).

The Default Mode Network (DMN)

 doi:10.20944/preprints202602.1324.v1

These structures belong to the Default Mode Network (DMN) (Raichle et al., 2001; Buckner et al., 2008; Raichle & Snyder, 2007)—active when the brain is not engaged in external tasks (when you rest, think, dream, remember, imagine the future). It is the network of self-reference.

The DMN comprises:

- Midline structures: vmPFC, posterior cingulum, precuneus
- Lateral parietal cortex: Temporo-parietal junction
- Medial temporal regions: Hippocampus, perirhinal cortex

When the DMN is intact, you experience yourself as a coherent entity with a past, present, and future. You can reflect on yourself and construct a narrative of yourself.

But when the DMN fragments—which occurs in severe trauma, depression, or psychosis—the self also fragments. The patient reports: "I don't know who I am. My life makes no sense. I'm trapped in the present moment" (Northoff et al., 2020; van der Kolk, 2014).

2.3. PILLAR 3: Neural Timescales and the Autorelational Window

The Multiscale Hierarchy of the Brain

The brain does not operate on a single frequency or timescale. It is a hierarchy of timescales—different regions operate at different temporal frequencies, from milliseconds to minutes or longer (Northoff, 2014).

Intrinsic Neural Timescales (INT)—the characteristic temporal constant over which each brain region integrates its activity with itself (Northoff, 2014).

Lower sensory areas have short INTs—milliseconds to about 100 ms. They respond quickly to sensory input.

Middle associative areas have longer INTs—roughly 100 ms to one or two seconds.

Higher prefrontal and limbic areas (vmPFC, anterior cingulate, hippocampus, DMN) have much longer INTs—from several seconds to minutes or more (Northoff, 2014).

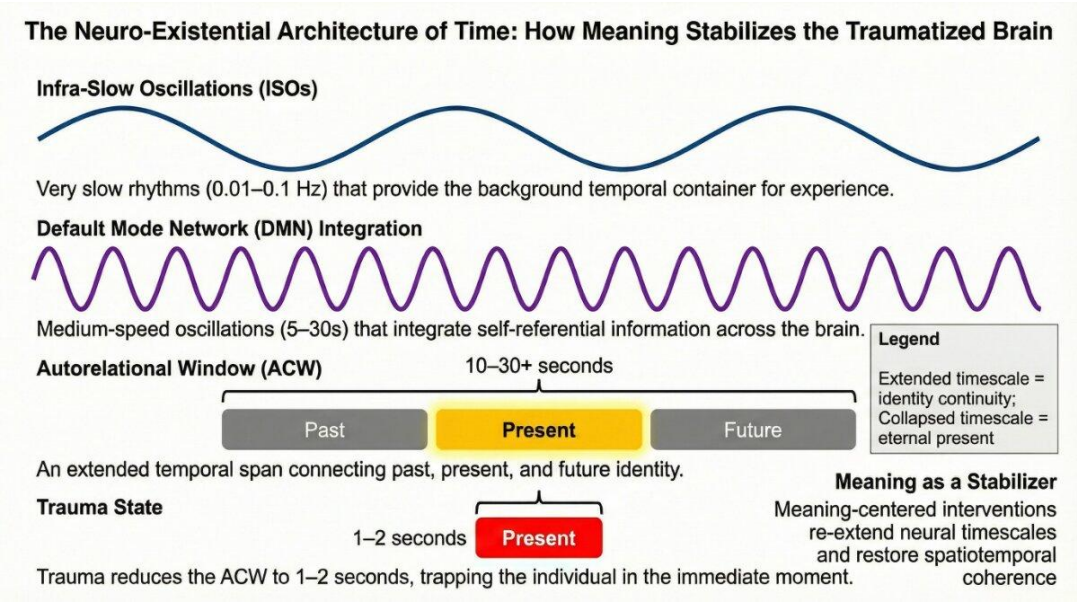

Figure 4. Neural Timescales and Autorelational Window (ACW): Proposed Trauma Effects and Meaning-Mediated Recovery.

Note. Conceptual model hypothesizing interactions among three neural oscillation systems supporting temporal self-continuity. Infra-slow oscillations (ISOs; 0.01–0.1 Hz, deep blue): Proposed background temporal scaffold. Default Mode Network (DMN; 0.1–0.3 Hz, purple): Hypothesized self-referential integrator. ACW: In healthy states, theorized to span 10–30+ seconds, unifying past-present-future awareness.

 doi:10.20944/preprints202602.1324.v1

Trauma state (red): Hypothesized ISO disruption + DMN decoherence collapse ACW to ≈1–2 seconds, trapping consciousness in present-bound fragmentation. Recovery (green): Meaning-centered interventions proposed to re-stabilize ISOs/DMN and re-extend ACW toward 30+ seconds.

Schematic hypothesis only; empirical validation pending (see Section 6 neuroimaging).

Abbreviations: ACW, autorelational window; DMN, default mode network; ISO, infra-slow oscillation.

This hierarchy of timescales is functionally necessary: To pursue longer-term goals, to form a narrative, to connect your actions from five minutes ago with your present moment, your system requires longer integration windows (Northoff, 2014).

The Autorelational Window and Identity

The Autorelational Window (ACW)—the temporal window over which a neuron's or region's activity correlates with its own past activity (Northoff & Bermpohl, 2004; Knyazev et al., 2020).

A long ACW means the region "remembers" its own state over extended time. The vmPFC, with its very long ACW, "remembers" its own state over extended windows. This enables the present moment to be linked with memories of the past and expectations of the future (Northoff, 2014).

Without this long ACW, one would have only the eternal present—no sense that you were the same person yesterday. This is what traumatized patients describe: "I am trapped in the present moment" (Northoff, 2014).

In severe trauma, the ACW collapses dramatically. The patient becomes stuck in an eternal now, without continuity to past or future. This is neurobiologically real and measurable with modern neuroimaging (Northoff, 2014; Knyazev et al., 2020).

Clarification of terminology. In line with Northoff (2014), we use the term autorelational window (ACW) to denote a *temporal autocorrelation property* of ongoing activity in cortical midline regions (including vmPFC and anterior cingulate cortex), rather than a novel oscillatory "wave" in the ACC. ACW indexes the timescale over which these regions maintain self-correlation and thus support temporally extended self-reference. It can be estimated from resting-state fMRI or EEG by computing the decay of the autocorrelation function over time lags

Meaning-Reconstruction and ACW Extension

Meaning reconstruction through narration re-extends the ACW. A coherent narrative is, by definition, a temporally extended connection of events. When this narrative is repeatedly and stably activated, it activates the longest timescales of the brain: the vmPFC, hippocampus, and Default Mode Network (Raichle et al., 2001; Buckner et al., 2008). With time and repetition, the ACW is re-extended (Northoff, 2014). The self regains temporal continuity.

This shows that identity is supported by stable meaning—that the feeling "I am continuous, I am the same person" fundamentally depends on a stable meaning-prior (Northoff, 2014; Frankl, 1946/2006).

Within a predictive-coding framework, ACW can be viewed as a timescale parameter of higher-level priors: regions with longer ACW integrate prediction errors over extended time, thereby stabilizing high-level self- and meaning-related models.

2.4. PILLAR 4: Tucker-Luu Framework—The Balance Between Two Limbic Systems

Two Evolutionary Systems

Don Tucker and Phan Luu argue that the limbic system comprises two relatively independent, mutually complementary subsystems with different neuroanatomy, neurochemistry, and functional roles (Tucker & Luu, 2025; Aston-Jones & Cohen, 2005; Porges, 2021).

The Papez System (Dorsal, Excitatory)

Characterized by:

- Neurochemistry: Dopamine + Noradrenaline (Aston-Jones & Cohen, 2005; Bouret & Sara, 2005)
- Anatomy: Dorsal-lateral and dorsomedial limbic structures (medial prefrontal system, reward loop via nucleus accumbens, locus coeruleus; Aston-Jones & Cohen, 2005)
- Function: Seeking behavior, hope, agency, motivation, future projection (Tucker & Luu, 2025)

 doi:10.20944/preprints202602.1324.v1

- Phenomenology: "I trust my models. My goals are possible. I will move forward" (Tucker & Luu, 2025)

The Yakovlev System (Ventral, Inhibitory)
Characterized by:

- Neurochemistry: GABA + Acetylcholine (Porges, 2021; Dana, 2018)
- Anatomy: Ventral-medial and ventral-lateral limbic structures (insula, ventral striatum, hippocampus, cholinergic basal structures; Porges, 2021; Dana, 2018)
- Function: Error-checking, safety evaluation, caution, risk aversion, realism (Tucker & Luu, 2025; Porges, 2021)
- Phenomenology: "Wait. Something could go wrong. Check your assumptions. Have you considered the risks?" (Tucker & Luu, 2025)

The Problem: Dominance Creates Psychopathology

Psychic disorders do not arise from the absence of one system, but from the dominance of one system over the other (Tucker & Luu, 2025).

When Papez is dominant: Excessive hope without reality-checking. Too much dopamine, too much agency. This manifests as mania, grandiose disorders, impulsive decisions.

When Yakovlev is dominant: Excessive pessimism, over-focus on errors and dangers. Too much inhibition, too much worry, too much fear. This manifests as anxiety disorders, depression, paralysis, nihilism.

The solution is not to strengthen or weaken one system, but to restore balance between them (Tucker & Luu, 2025).

Criticality and Optimal Function

Tucker and Luu employ criticality from complex systems to describe optimal function. A critical system operates at the boundary between order and chaos (Tucker & Luu, 2025; Beggs & Plenz, 2003).

At this critical state:

- The system is not rigid (too much order)
- The system is not chaotic (too much chaos)
- The system is alive, adaptive, flexible

An optimally functioning limbic system oscillates continuously between Papez (hope, agency, meaning-projection) and Yakovlev (verification, realism, caution) (Tucker & Luu, 2025). This state of criticality is the goal—not a fixed diagnosis, but a dynamic equilibrium (Tucker & Luu, 2025; Strogatz, 2018).

2.5. PILLAR 5: Infra-Slow Oscillations and Affective Criticality

The brain is a complex hierarchy of rhythms, from fast brain waves (Beta, Gamma, 15–100 Hz) to extremely slow rhythms (Raichle & Snyder, 2007; Northoff, 2014).

Infra-Slow Oscillations (ISOs) with frequencies of only 0.01–0.1 Hz occur primarily in the Default Mode Network and function as a background temporal container that structures, orchestrates, and stabilizes faster oscillations (Raichle & Snyder, 2007; Keilholz et al., 2013).

When ISOs are strong and stable, the brain can integrate high emotional and sensory intensity—intense feelings, chronic pain, surprise—without fragmenting or dissociating (Keilholz et al., 2013). The intensity is held within a larger temporal container and processed.

When ISOs are weak or destabilized—as in trauma or chronic stress—this container collapses. The system is easily overwhelmed by fast emotional signals and can no longer self-organize. The patient fragments (Raichle & Snyder, 2007; van der Kolk, 2014).

Meaning-centered activities—existential reflection, meditation, the process of meaning-making itself—naturally activate the Default Mode Network and strengthen ISOs (Raichle et al., 2001; Frankl, 1946/2006). With repeated, conscious activation, ISOs become more robust and stable. The temporal container for emotional and sensory experience enlarges and solidifies (Keilholz et al., 2013; Raichle & Snyder, 2007).

 doi:10.20944/preprints202602.1324.v1

This rhythmic stabilization is intimately connected with the ACW phenomenon: A stable ISO pattern enables the brain to maintain the longer timescales necessary for an extended ACW (Leidig, 2026).

2.6. Synthesis: The Five Pillars as Coherent Architecture

1. Predictive Coding (Friston, 2010; Hohwy, 2013) explains how: the brain functions as an error-minimizing system across multiple hierarchical levels.
2. Default Mode Network (Northoff, 2014; Buckner et al., 2008) identifies where: these processes occur—in specific brain structures.
3. Intrinsic Neural Timescales and ACW (Northoff, 2014) explains when and DURATION: longer timescales in higher structures enable identity and continuity.
4. Tucker-Luu Framework (Tucker & Luu, 2025) explains balance: optimal function emerges from dynamic equilibrium between two limbic systems—criticality (Beggs & Plenz, 2003).
5. Infra-Slow Oscillations (Raichle & Snyder, 2007; Keilholz et al., 2013) explains rhythm: emotional and cognitive states are structured and stabilized by background temporal rhythms.

Together, these five pillars create a coherent, multi-layered understanding of how the brain functions. They prepare the ground for the NEAS's central thesis: meaning is not merely psychological, but fundamentally neurobiological—an organizing principle that stabilizes all these dimensions simultaneously (Northoff, 2014; Singer, 2021).

SECTION 3: NEAS MODEL—THE four MECHANISMS

3.0. Introduction

Now we integrate the five pillars into four core neurobiological mechanisms through which meaning is hypothesized to stabilize the traumatized brain and restore resilience (Leidig, 2026; Singer, 2021). These four mechanisms are not separate, isolated processes; rather, they are aspects of a single, integrated, cascading system-level reorganization (Northoff, 2014; Melloni et al., 2021).

Each mechanism targets a different dimension of the catastrophic breakdown that trauma causes:

- Mechanism 1 addresses hierarchical fragmentation (the collapse of top-down organization).
- Mechanism 2 addresses limbic dysbalance (the oscillation between hope and despair).
- Mechanism 3 addresses temporal incoherence (the loss of identity continuity and emotional container).
- Mechanism 4 provides structural meta-stabilization (the Witnessing-Space that holds content, emotion, and temporal flow without fragmentation).

Meaning-reconstruction activates all four mechanisms in an interdependent cascade. Meaning operates as such a powerful stabilizer because it addresses multiple levels of breakdown at once, creating system-level restoration rather than isolated symptom relief (Leidig, 2026).

3.1. Mechanism 1: Hierarchical Recalibration via Meaning-Priors

The Hierarchical Problem in Trauma: Proposed Neurobiological Account

The brain is organized as a hierarchical processing system, with sensorimotor processes at lower levels and self-referential, narrative, and meaning-generating functions at higher cortical levels (Northoff, 2014; Singer, 2021). Trauma is hypothesized to disrupt this hierarchy by decohering processing across levels: lower sensory and subcortical emotion regions generate unfiltered prediction errors that overwhelm higher cognitive and identity networks, while top-down regulatory signals fail to provide adequate contextual modulation (van der Kolk, 2014; Northoff et al., 2020).

The phenomenological result—profound fragmentation—is familiar to trauma clinicians: patients report "I don't know who I am anymore. Nothing makes sense. My memories don't fit

 doi:10.20944/preprints202602.1324.v1

together. I'm in pieces" (van der Kolk, 2014). This state is proposed to reflect genuine neurobiological decoherence across hierarchical levels (Northoff et al., 2020; Melloni et al., 2021).

Candidate Neuroanatomical Locus: Layer V Apical Dendrite Gating

A candidate site for this hierarchical breakdown is Layer V of neocortex, which may serve as a critical integration and gating interface (Singer, 2021; Melloni et al., 2021). Layer V pyramidal neurons possess apical dendrites extending into Layer I, creating an anatomical convergence where:

- Top-down predictions from higher cortical layers arrive via apical dendritic inputs
- Bottom-up error signals from lower layers, thalamus, and subcortical structures arrive via axonal synapses

Under normal conditions, this Layer V system is proposed to function as a dynamic gating mechanism, selectively filtering and modulating bottom-up signals based on contextual relevance: salient errors propagate upward for higher-level processing; routine discrepancies are handled locally (Singer, 2021; Melloni et al., 2021).

Stress-induced compromise: High cortisol levels during trauma are known to induce apical dendrite retraction in Layer V pyramidal neurons (Shansky et al., 2009; McEwen, 2007). This retraction is hypothesized to impair gating function, permitting unfiltered sensory-emotional error signals to propagate upward unchecked (Singer, 2021). Higher cortical regions then receive this "cacophony" of uncoordinated bottom-up activity and struggle to maintain organizational coherence (Northoff et al., 2020).

Meaning-Reconstruction as Proposed Stabilizer: Top-Down Recalibration

Meaning reconstruction is proposed to initiate hierarchical recovery through a stable meaning-prior—a coherent, value-laden representation anchored in vmPFC and integrated across the Default Mode Network—that generates organizing top-down signals cascading downward (Friston, 2010; Ecker et al., 2012; Frankl, 1946/2006; Leidig, 2026).

Proposed neurobiological sequence:

1. Gating restoration: vmPFC meaning-priors are hypothesized to strengthen apical dendritic inputs, facilitating re-establishment of Layer V filtering capacity and selective signal modulation (Singer, 2021).
2. Laminar reweighting: Balance between feedforward (bottom-up) and feedback (top-down) signaling across cortical layers shifts toward higher-level precedence, re-establishing hierarchical organization (Melloni et al., 2021).
3. Generative model reactivation: Stable representations in deep cortical layers resume top-down influence over lower sensory processing (Friston, 2010; Ecker et al., 2012).
4. Cross-level coherence: Lower sensory-emotional signals become recontextualized within higher-level existential frameworks rather than driving isolated fragmentation (Northoff, 2014; Singer, 2021).

Clinical Illustration: From Fragmentation to Proposed Integration

Consider Sarah, survivor of childhood sexual abuse. Initially her system exhibits hierarchical decoherence:

- Lower sensory-limbic: "Danger. Violation. Terror." (amygdala/insula)
- Middle associative: "This shouldn't happen. Contradicts everything." (confusion)
- Higher self-referential: "I'm broken. Worthless. No meaning." (despair)

Through meaning-centered therapy, Sarah develops an integrative meaning-prior:
"The violation was wrong and I was not responsible. AND I survived. My vulnerability is human. My task is to carry wounds with dignity and build meaning through service."

This framework is proposed to generate stabilizing top-down signals: lower levels acknowledge vulnerability *within* higher-level context ("human condition"), middle levels achieve coherence ("world is harsh *and* meaningful"), highest levels regain stability ("wounded *and* worthy"). Hierarchical decoherence yields to proposed reintegration.

 doi:10.20944/preprints202602.1324.v1

3.2. Mechanism 2: Emotional Criticality as Meta-Regulation

The Limbic Dysbalance Problem: Two Systems in Conflict

We have established from the Tucker-Luu framework that the limbic system does not function as a monolithic "emotion system," but comprises two relatively independent, complementary but often conflicting subsystems (Tucker & Luu, 2025; Aston-Jones & Cohen, 2005; Porges, 2021). Trauma severely dysregulates the balance between these two systems, often locking the person into dominance of one system (usually Yakovlev freeze-dominant in complex trauma) or causing chaotic oscillation between extremes (Porges, 2021; van der Kolk, 2014).

In trauma survivors, we commonly observe:

- Chronic Yakovlev dominance (particularly dorsal vagal freeze): Chronic pessimism, hopelessness, shutdown, dissociation, inability to access agency or hope. The person is stuck in "nothing is possible, nothing matters" (Tucker & Luu, 2025; Dana, 2018).
- Dysregulated oscillation: Alternating, unpredictable swings between Papez activation (brief manic-like periods, impulsive behavior) and Yakovlev dominance (collapse into hopelessness), without the fluid, flexible oscillation characteristic of a healthy system (Tucker & Luu, 2025).

In either case, the system has lost criticality—the dynamic equilibrium at the boundary between order and chaos that characterizes optimal emotional function (Beggs & Plenz, 2003; Tucker & Luu, 2025).

Optimal Emotional Function: Criticality and Dynamic Balance

Tucker and Luu propose that optimal emotional-cognitive function exists at criticality—not a fixed state, but a dynamic equilibrium operating at the boundary between rigid order and chaotic disorder (Tucker & Luu, 2025; Strogatz, 2018). At criticality, the system is:

- Alive and responsive (not rigid and mechanistic)
- Adaptive and flexible (can adjust to change)
- Integrative (can hold contradictions and complexity)
- Resilient (can withstand perturbations without collapsing or rigidifying)

An optimally functioning limbic system—one at criticality—continuously oscillates between Papez dominance (hope, agency, forward-projection, sense that goals are possible, dopaminergic activation) and Yakovlev dominance (caution, reality-checking, error-monitoring, restraint, acetylcholine/GABA modulation) (Tucker & Luu, 2025). This oscillation is not a problem; it is the solution. It looks like:

- Moment 1: I believe my goal is possible. I move forward with energy. (Papez activation, slight dominance)
- Moment 2: I pause and check reality. I consider risks. I course-correct. (Yakovlev activation, slight dominance)
- Moment 3: Back to integrated hope-realism: I understand the risks, and I can proceed meaningfully. (Balance restored)

This continuous oscillation, at criticality, is what permits genuine resilience and meaning-engagement: the person can hope and acknowledge difficulty, can pursue goals and prepare for obstacles, can feel grief and maintain purpose (Tucker & Luu, 2025; Taleb, 2012).

Meaning as Meta-Regulator: The Dual Architecture

Here is the core insight: Meaning functions as a meta-regulator of this Papez-Yakovlev oscillation, stabilizing it around a coherent center (Leidig, 2026; Tucker & Luu, 2025).

Meaning has a dual architecture that permits this meta-regulatory function:

1. Logos-Vektor: The directed, narrative dimension of meaning—the conscious story you construct and tell about your life. "My suffering has purpose. My life is moving toward something meaningful. My existence matters because _____." This dimension is forward-looking, goal-directed, hope-activating. It engages Papez activation (Frankl, 1946/2006; Tucker & Luu, 2025).

 doi:10.20944/preprints202602.1324.v1

2. Witnessing Space: The non-narrative, implicit dimension of meaning—pure awareness, the field in which experience arises, independent of whether the narrative is "succeeding." It is presence without goal-orientation, acceptance without judgment. It engages Yakovlev restraint, reality-checking, compassionate observation (Tedeschi & Calhoun, 2004; Tucker & Luu, 2025).

The two together permit true antifragility: The person can simultaneously narrate forward (Logos-Vektor activates Papez—hope, forward-projection) AND witness without judgment (Witnessing Space engages Yakovlev restraint—reality-check, non-reactivity). This dual engagement creates criticality: the system is alive, adaptive, able to hold contradictions (Taleb, 2012).

How This Enables Criticality: The Oscillation Around a Stable Center

Without stable meaning, Papez-Yakovlev oscillation is erratic and unpredictable. The person may swing wildly between manic hope ("I'm completely healed! I'll never feel pain again!") and depressive despair ("I'm permanently broken. Life is meaningless"). This is oscillation around no stable center—chaotic rather than critical (Tucker & Luu, 2025).

With stable meaning, the oscillation becomes centered: The Papez-Yakovlev oscillation happens around a stable meaning-center rather than chaotically. The meaning-center provides what we might call the "metronome" or "attractor" for emotional balance—a stable reference point that keeps the oscillation functional rather than chaotic (Leidig, 2026).

Here is how it works:

- The meaning-center says: "My life has fundamental meaning and purpose, even though this moment is difficult."
- Papez activation happens within this frame: "My goals are challenging but possible. I can move forward."
- Yakovlev activation happens within this frame: "I need to be realistic about obstacles and pace myself."
- The oscillation continues, but centered: Each moment of hope is grounded in meaning, not manic inflation. Each moment of caution is realistic, not depressive collapse.

The result: Criticality. The system is alive, adaptive, able to integrate intensity without fragmenting (Tucker & Luu, 2025; Beggs & Plenz, 2003).

Clinical Example: From Dysbalance to Criticality

Consider Marcus, a trauma survivor with Yakovlev-dominant dysregulation. His initial state:

- Chronic hopelessness: "Nothing will get better. My life is ruined. I might as well not try."
- Inability to access agency: Even when small opportunities arise, he cannot mobilize energy to pursue them.
- Dorsal vagal shutdown: Emotional numbness, dissociation, withdrawal.

This is not healthy caution; it is dysregulation, with Yakovlev system running unopposed by Papez activation (Tucker & Luu, 2025; Dana, 2018).

Through meaning-centered work, Marcus gradually develops a stable meaning-framework: "What happened to me was devastating, and I have learned something from it. I am building a life oriented toward helping other survivors. This work gives my life direction. I may not ever be 'healed' in the sense of having no scars, but I can be whole—I can integrate the scars into a meaningful identity."

As this meaning stabilizes, something remarkable happens:

- Papez activation becomes possible again: Marcus can feel hope about his mentor work, can mobilize energy toward meaningful goals. But this hope is not manic or inflated; it is grounded in his meaning-framework.
- Yakovlev caution remains; it's recontextualized: Marcus still acknowledges limitations, paces himself, respects his wounds. But caution is no longer depressive resignation; it is wise, realistic self-care within a meaningful endeavor.
- The oscillation becomes critical: Hope and caution oscillate fluidly, both serving the larger meaning-framework. Marcus is alive, adaptive, resilient (Tucker & Luu, 2025; Leidig, 2026).

 doi:10.20944/preprints202602.1324.v1

He still has hard days. He still grieves. But he achieves something fundamental: emotional criticality. His two limbic systems work together, oscillating around a stable meaning-center, permitting genuine resilience and engagement (Frankl, 1946/2006; Tucker & Luu, 2025).

3.3. Mechanism 3: Spatiotemporal Coherence

Part A: Narrative Continuity and ACW Extension

The self is not a localized thing sitting at one place in the brain. It is a temporal process extending across time. The self is carried through the integration of neural activity across long timescales—a phenomenon mathematically measured as the Autorelational Window (ACW) (Northoff, 2014; Knyazev et al., 2020).

In healthy individuals, the ACW extends for several minutes or longer. This enables narrative continuity: I am the person who made this decision five minutes ago. I am the person who had that memory yesterday. I am the person who will pursue these goals next week. My life is a connected story.

But in severe trauma, the ACW collapses. The patient becomes trapped in an eternal now, without continuity to past or future. This is not metaphor—it is neurobiologically real and measurable (Northoff, 2014; Knyazev et al., 2020).

Meaning-Reconstruction Through Narration Re-Extends the ACW

Here is the mechanism: A coherent narration is, by definition, a temporally-extended connection of events. When this narration is repeatedly and stably activated—through therapeutic storytelling, existential reflection, therapeutic processing—it reactivates the longest timescales of the brain: the vmPFC, hippocampus, and Default Mode Network (Raichle et al., 2001; Buckner et al., 2008).

The vmPFC, with its intrinsically long timescales (multiple seconds to minutes), begins to "remember" its own state across extended periods when repeatedly engaged in narrative reflection. The hippocampus, which encodes spatiotemporal context, reactivates its function of binding events into sequence.

With time and repetition, the ACW re-extends. The patient gradually recovers the sense of continuous selfhood across time. This re-extension of ACW has enormous implications: identity is recovered through meaning-centered narrative work. The feeling "I am continuous, I am the same person" fundamentally depends on a stable meaning-prior that sustains itself across extended timescales (Northoff, 2014; Frankl, 1946/2006).

Part B: Rhythmic Stabilization Through Infra-Slow Oscillations

But narrative alone is not the complete story. Temporal coherence also depends on rhythmic stabilization through infra-slow oscillations.

Infra-slow oscillations (0.01–0.1 Hz) are extremely slow rhythms that occur primarily in the Default Mode Network. They function as a background temporal container—a rhythmic scaffold that structures, orchestrates, and stabilizes faster neural oscillations (Raichle & Snyder, 2007; Keilholz et al., 2013).

Fast brain waves (Beta, Gamma, 15–100 Hz) carry the "language" the brain speaks—specific computations, ideas, emotional reactions. But without a stable, slow background rhythm, these fast waves would be chaotic—they wouldn't assemble into something coherent. The ISOs are the background tempo on which all faster tempos are played. They structure, orchestrate, bring coherence.

When ISOs are strong: The brain can integrate high emotional and sensory intensity—intense grief, rage, physical pain, surprise—without fragmenting or dissociating. The intensity is held within a larger temporal container and processed.

When ISOs are weak: This container collapses. The system is easily overwhelmed by fast emotional signals. The patient fragments (Raichle & Snyder, 2007; van der Kolk, 2014).

Meaning-centered activities strengthen ISOs: Existential reflection, meditation, the process of meaning-making itself naturally activate the Default Mode Network and strengthen ISOs (Raichle et al., 2001; Frankl, 1946/2006). This is probably because these activities naturally operate on the longest

 doi:10.20944/preprints202602.1324.v1

timescales of the system. With repeated, conscious activation, ISOs become more robust and stable. The temporal container for emotional and sensory experience enlarges and solidifies (Keilholz et al., 2013; Raichle & Snyder, 2007).

Part C: Integration—ACW and ISO Working Together

These two mechanisms—ACW extension through narrative and ISO stabilization through meaning-activation—are not separate. They are complementary and mutually reinforcing.

A stable ISO pattern enables the brain to maintain the longer timescales necessary for an extended ACW. Conversely, an extended ACW (sustained through narrative) naturally activates and stabilizes ISOs.

Together, they create spatiotemporal coherence: The patient regains both narrative continuity across time (ACW) and emotional resilience within moments (ISO stability). The self becomes not just remembered, but felt as continuous and resilient (Northoff, 2014; Singer, 2021; Leidig, 2026).

3.4. MECHANISM 4: WITNESSING-SPACE AS STRUCTURAL META-STABILIZATION

3.4.1. Definition and Conceptual Status: The Structural Master Prior

The first three mechanisms address content, balance, and rhythm respectively. Mechanism 4 represents a qualitative shift to a meta-level of organization: the capacity of the nervous system to become aware of its own organization, and to stabilize that self-awareness as a structural property capable of holding high-entropy states without fragmentation.

We define Witnessing-Space as a structural master prior—a neurobiologically instantiated capacity for non-identified awareness that operates not on the what of experience (Mechanism 1), the how-to-balance of emotion (Mechanism 2), or the when of temporal sequence (Mechanism 3), but on the wherein—the container, field, or space within which all three mechanisms operate.

Phenomenologically, this is the difference between being identified with one's thoughts, emotions, and narratives versus being aware of them. A trauma survivor might say: "I am not the pain; I am the space in which pain arises." This shift in identification—from content to container—is not metaphorical. It reflects a measurable reorganization of neural binding and precision-weighting (Melloni et al., 2021; Friston, 2023).

The crucial distinction is between semantic priors (Mechanism 1: meaning content) and structural priors (Mechanism 4: how information is organized). Logos-Vektor (directed narrative toward valued future) operates through semantic priors—they predict what will happen and organize content accordingly. The Witnessing-Space operates through structural priors—they determine how the system processes information, independent of content. Structural priors are metabolically cheaper than semantic priors; they don't require constant belief-updating or narrative maintenance (Friston, 2023; Hohwy, 2013).

Thus, the Witnessing-Space functions as the "operating system" that permits the "applications" of meaning (Logos), emotional balance (Criticality), and temporal coherence (Rhythmicity) to run without system crashes under extreme conditions. Without this operating system, sophisticated meaning-work may founder when the system encounters contradiction or overwhelming sensation.

3.4.2. Phenomenology: From Narrative Time-Flow to Presence-Space

To understand Witnessing-Space phenomenologically, we can invoke Wagner's line from *Parsifal*: „Zum Raum wird hier die Zeit"—here, time becomes space. The narrative self (Mechanism 1) is organized diachronically: it needs a linear flow of past–present–future to construct autobiography; the „I" is a story unfolding in time (Gallagher, 2005; Northoff & Bermpohl, 2004). When trauma shatters this thread, the self dissolves and the survivor asks: „Who am I if my story no longer makes sense?" (van der Kolk, 2014; Frankl, 1946/2006).

Witnessing-Space represents a shift from temporal (diachronic) to spatial (synchronic) organization. Rather than becoming through time, the self learns to be in a spacious, non-temporal present. Contemplative traditions describe this as nunc stans, the „standing now" (Thomas Aquinas,

 doi:10.20944/preprints202602.1324.v1

2000; Husserl, 1991): not a thin slice between past and future, but a presence that is not moving anywhere, in which past and future lose their grip. Clinically, a trauma patient might say: „The memory is still there, but it no longer pulls me forward into fear or backward into regret. It just is. And I am the space in which it is“ (Britton, 2015; Safran, 2003).

Phenomenologically, Witnessing-Space is characterized by a sense of boundless presence and meta-awareness that is both intimate and distant, identified and disidentified (Gallagher & Zahavi, 2012; Lutz et al., 2007). It is, in a sense, awareness returning to its own source—the recursive self-knowledge that allows the self to hold itself without collapse.

3.4.3. Neurobiological Basis: Wolf Singer's Binding by Synchrony

The question is: what is the neurobiological mechanism by which global awareness (Witnessing-Space) is instantiated? The answer lies in Wolf Singer's theory of Binding by Synchrony (BBS), one of the most important yet underutilized frameworks in understanding consciousness (Singer, 1999, 2021; Singer & Gray, 1995).

Singer's fundamental insight is this: the brain is a massively distributed system without a central command center. Millions of neurons across distant brain regions must somehow coordinate their firing to produce unified perception and conscious awareness. How? Not through anatomical convergence (there is no central hub), but through precise temporal synchronization of neural firing patterns.

In unconscious processing—sensorimotor reflexes, automatic memory retrieval, habit execution—neurons fire in a relatively asynchronous manner. Local groups of neurons show synchronized activity (local binding), but there is no global integration. The information is processed in parallel streams that never fully integrate. This is why we can drive a familiar route without conscious awareness (Dehaene & Changeux, 2011; Melloni et al., 2011).

In conscious perception, by contrast, neurons across multiple brain regions synchronize their firing in the gamma frequency range (approximately 30-80 Hz) (Singer, 1999; Tallon-Baudry & Bertrand, 1999). This gamma-frequency synchronization creates a global "binding" across distributed regions. When you see a face, color-detecting neurons in V4, motion-detecting neurons in MT, and identity- processing neurons in the fusiform gyrus all fire in synchronized gamma bursts, creating a unified percept (Singer, 2021; Melloni et al., 2021). This synchrony is what consciousness is—not the firing of neurons in a particular region, but their coordinated temporal relation across regions (Singer & Gray, 1995).

For Witnessing-Space specifically, the implications are profound. The shift from narrative self-consciousness (object consciousness: aware of thoughts, emotions, memories) to meta-awareness (subject consciousness: aware of the space of awareness itself) corresponds to a shift in the scale and quality of gamma synchronization (Lutz et al., 2004; Britton, 2015; Singer, 2021). In object consciousness, gamma synchrony binds specific contents—this thought, that emotion, the narrative. In Witnessing-Space consciousness, gamma synchrony binds across an enormous range of neural populations simultaneously, creating a state of maximal relational coherence.

Research on advanced meditators demonstrates this empirically. Lutz et al. (2004) found that Tibetan Buddhist monks in deep meditation show sustained gamma-frequency oscillations (25-40 Hz) at amplitudes significantly exceeding those of control subjects—and this occurs across all electrode positions, indicating global binding rather than localized activity (Lutz et al., 2004). The authors conclude that this global synchronization reflects "the neural signature of consolidated consciousness," a state in which the distinctions between observer and observed momentarily dissolve (Singer, 2021).

Importantly, Singer's model distinguishes between two types of synchrony:

(1) Intra-regional synchrony: Neurons within a local circuit synchronize to process a specific feature (e.g., color in V4). This supports feature binding and object representation. It is object-consciousness.

 doi:10.20944/preprints202602.1324.v1

(2) Inter-regional synchrony: Neurons across distant regions synchronize through long-range connections (mediated by gap junctions, common input, and reciprocal connections). This supports global binding. It is meta-consciousness, Witnessing-Space.

The Witnessing-Space represents a dominance of inter-regional, long-range gamma synchronization. This creates a state in which the brain's own organization becomes transparent to itself. The "self" is no longer identified with local content (thoughts, memories) but with the global field that contains all such content (Singer, 2021; Northoff & Bermpohl, 2004).

This explains why the Witnessing-Space is antifragile. Fragmentation occurs when different neural regions operate in isolation (asynchrony). Depression, PTSD, and dissociation are characterized by precisely this: loss of global integration, with different brain systems running in parallel without coordination (van der Kolk et al., 2005; Lanius et al., 2010). The Witnessing-Space, by maintaining maximal inter-regional gamma synchronization, prevents such fragmentation even when individual content streams (thoughts, memories, emotions) are chaotic or contradictory (Singer, 2021; Lutz et al., 2007).

In the present framework, gamma synchrony is operationalized in a narrow-band 30–45 Hz range over long-range connections between midline hubs (vmPFC, dmPFC, PCC) and temporo-parietal regions (TPJ), in line with prior work on large-scale binding and meditation-related meta-awareness. We deliberately avoid the very high-frequency (>60–80 Hz) bands often implicated in epileptiform activity or acute stress responses, and we interpret gamma changes only in conjunction with improvements in ACW, DMN integration, and clinical outcomes

We explicitly acknowledge that gamma activity is not uniformly “good”: context and topology matter. Pathological gamma increases have been observed in epilepsy and anxiety, whereas distributed, long-range gamma coherence coupled with improved clinical function has been associated with contemplative meta-awareness. Our hypotheses therefore treat gamma synchrony as a *candidate* marker of Witnessing-Space only when embedded in a broader mechanistic and clinical pattern.

3.4.4. Integration with Northoff: The Autorelational Window (ACW) as Bridge

Georg Northoff's temporal neuroscience provides the crucial link between Singer's binding theory and the brain's extended temporal organization. As detailed in Section 3.3 (Mechanism 3), the autorelational window (ACW) measures the time-lag at which the brain's resting-state activity still correlates with its own prior state—the window over which the brain maintains self-reference (Northoff & Bermpohl, 2004; Northoff, 2014).

Trauma acutely shortens the ACW. A survivor in hyperarousal shows ACW <10-20 seconds; the present moment is disconnected from its own past, leading to temporal fragmentation and the sense of perpetual threat (Northoff, 2014; van der Kolk, 2014). Mechanisms 1-3 work to extend the ACW through meaning-work, emotional balancing, and narrative processing.

But here is where Witnessing-Space adds a critical dimension: while Mechanisms 1-3 extend the ACW through content-dependent processes (getting the narrative right, balancing emotions), Witnessing-Space extends the ACW through structural reorganization. By maintaining global inter-regional gamma synchronization (Singer), the Witnessing-Space creates a spatiotemporal container that is independent of the particular content flowing through it (Northoff, 2014; Singer, 2021).

This is measurable. In meditation research, ACW consistently shows extension in advanced practitioners. But the mechanism is not that they are "thinking better" or "feeling better"—the content is often identical to non-meditators—but that they have reorganized the structure of their brain's self-relation (Northoff, 2014). The ACW extends because the brain has learned to maintain coherence across broader timescales through gamma binding, not through semantic elaboration.

Thus, the ACW serves as a measurable bridge between Singer's microscale binding mechanism and Northoff's macroscale temporal organization. Witnessing-Space, operationalized as enhanced inter-regional gamma synchrony, directly predicts ACW extension. And ACW extension is precisely

 doi:10.20944/preprints202602.1324.v1

one of our primary outcome measures for validating the clinical effectiveness of Mechanism 4 (see Section 6.1, Hypothesis 1).

3.4.5 Integration with Ciompi: Affective Criticality and the Dissonance-to-Resonance Transition

Luc Ciompi's theory of affective logic reveals how emotion orchestrates thought at multiple scales (Ciompi, 1997; Tschacher & Haken, 2007). The brain is fundamentally an affective system; cognition is always colored by feeling-tone. Trauma dysregulates this affective orchestration, often locking the system into rigid attractor states— rigid emotional patterns that resist change (Tschacher & Haken, 2007; Schiepek et al., 2013).

Ciompi observes that psychological change occurs not through gradual modification of these attractor states but through sudden phase transitions when the system reaches a critical point. At criticality—a state of maximal sensitivity and flexibility poised between order and chaos (Beggs & Plenz, 2003; Cramer et al., 2016)— the system can undergo rapid reorganization. Below criticality, the system is rigid; above criticality, it fragments; at criticality, it is exquisitely sensitive and capable of discontinuous leaps (Cramer et al., 2016; Schiepek et al., 2013).

Mechanism 2 (Emotional Criticality) brings the system to the edge of this critical point through limbic oscillation. But Witnessing-Space (Mechanism 4) permits the system to stay at criticality without either collapsing into disorder or retreating into rigidity (Singer, 2021; Schiepek et al., 2013).

The phenomenological correlate is the shift from affective dissonance (the tormenting gap between narrative hope and traumatic memory, between felt body and conscious belief, between who one wants to be and who one feels to be) to affective resonance (a state in which contradictions are held without resolution, yet generate a kind of harmony through their very tension, like overtones in music).

Ciompi's model, when integrated with Singer's BBS, suggests the mechanism: Witnessing-Space, through maximal inter-regional gamma synchronization, permits the brain to hold mutually contradictory affective and cognitive states in a state of dynamic equilibrium. The traumatic memory (I am terrified) and the safety signal (I am now safe) do not need to be reconciled or one suppressed. Both can be held in the vast container of Witnessing-Space, firing in gamma-synchronized patterns that create a superposition rather than a contradiction (Singer, 2021; Tschacher & Haken, 2007).

Clinically, this manifests as the patient's capacity to "feel both at once": grief and growth, vulnerability and strength, loss and meaning. The old binary thinking ("Either I heal or I suffer"; "Either I'm broken or I'm fixed") dissolves. The Witnessing-Space permits the paradox. And paradox is the hallmark of psychological maturity and resilience (Frankl, 1946/2006; Janoff-Bulman, 1992).

3.4.6. Integration with Melloni: Precision Control and the Mechanism of Non-Suppressive Healing

Lucia Melloni's research on hierarchical predictive processing illuminates a crucial mechanism by which Witnessing-Space produces clinical benefit: through precision control, not through suppression (Melloni et al., 2021; Friston et al., 2017).

The laminar architecture of the cortex (six layers) implements the predictive hierarchy (Melloni et al., 2021). Deep layers (V and VI) generate predictions (priors) and send them downward. Superficial layers (II and III) receive sensory input and generate prediction errors (unexpected signals) that propagate upward. The brain continuously asks: Do my predictions match reality? If not, what do I need to update?

In trauma, two pathological scenarios occur:

(1) Hyperactive error propagation: Sensory signals from the traumatic zone are treated as maximal prediction errors, triggering constant alarm and updating throughout the hierarchy. The brain is constantly being told: "This isn't what you expected; recalibrate!" This is hyperarousal.

(2) Error suppression: The brain actively inhibits these error signals, pushing them down, preventing them from reaching higher levels. This requires metabolic effort and generates dissociation.

 doi:10.20944/preprints202602.1324.v1

Both strategies are expensive and fragile. Mechanisms 1-3 try to address this by changing what the hierarchy predicts (Mechanism 1: new meaning), or by modulating the emotional valence (Mechanism 2), or by extending the timescale (Mechanism 3). These are valuable but limited.

Witnessing-Space implements a third strategy: precision weighting control (Melloni et al., 2021; Friston et al., 2017). The key parameter is not the signal's content or valence, but its precision—how confidently the brain should treat it as important information requiring response.

Through attention (particularly the dorsolateral prefrontal cortex's top-down modulation of deep layer circuits), Witnessing-Space practice shifts attention away from the content of experience (the trauma signal) toward the context of experience (the vast space of awareness in which all signals appear). This attention shift modifies the precision-weighting that deep layers assign to the error signal (Melloni et al., 2021; Friston et al., 2017).

Mechanistically: normally, a traumatic stimulus generates high-precision prediction error ("This is important! Respond!"). But when attention is directed toward the witnessing space, the brain recalibrates: this error signal is now treated as low- precision information ("This is just another thought arising in awareness"). The signal is not suppressed (which would require inhibitory effort), but down-weighted (which simply shifts attentional allocation).

The result: what we call "Quiet Neural Background" (QNB)—a dramatic reduction in the allostatatic load, not through force but through reallocation of attention (Melloni et al., 2021; Friston et al., 2017). The patient reports: "The pain is still there, but it's not demanding my attention anymore. It's just... present."

This is radically different from suppression. Suppression requires constant effort; QNB is energetically efficient. Suppression fragments the system (by isolating pain signals); QNB integrates (by including pain in a broader field). Suppression tends to rebound (return with increased intensity); QNB tends to stabilize (pain naturally loses salience when not amplified by fear) (Melloni et al., 2021; Friston et al., 2017).

3.4.7. Meta-Awareness as a Trainable Capacity: Evidence from Davidson and Contemplative Neuroscience

A critical question: Is Witnessing-Space a capacity that emerges spontaneously in some individuals, or can it be systematically cultivated through practice?

Richard Davidson's research on the neuroscience of well-being provides decisive evidence for the latter (Davidson & Begley, 2012). Davidson identifies meta-awareness—the capacity to be aware of one's own thoughts and emotions rather than being possessed by them—as one of four fundamental pillars of well-being (along with resilience, attention, and positive outlook).

Crucially, Davidson demonstrates that meta-awareness is a skill, not a fixed trait. Through contemplative practice (meditation, mindfulness), individuals can develop meta-awareness from a temporary state into a stable trait—a durable capacity that persists even outside of formal practice (Davidson & Begley, 2012).

The neural mechanism involves exactly what we have described: enhanced inter-regional gamma synchronization (Lutz et al., 2004; Singer, 2021). Advanced meditators show:

(1) Elevated baseline gamma power across multiple frequency bands (Lutz et al., 2004)

(2) Sustained gamma synchronization even during rest (not dependent on external task)

(3) Increased gray matter volume in regions associated with self-referential processing (dmPFC, posterior cingulate) (Hölzel et al., 2011)

(4) Reduced amygdala reactivity to emotional stimuli, with structural atrophy in the amygdala and functional decoupling from prefrontal regions (Hölzel et al., 2011)

(5) Enhanced resting-state functional connectivity between default-mode regions (indication of integrated self-representation) (Tang et al., 2015)

These changes are trainable. After just 8 weeks of mindfulness-based stress reduction (MBSR), naive practitioners show measurable increases in gamma power, gray matter in the insula (self-aware region), and functional integration between emotional and cognitive systems (Tang et al., 2015;

 doi:10.20944/preprints202602.1324.v1

Hölzel et al., 2011). After months or years of intensive practice, the changes become substantial and stable (Lutz et al., 2004).

The temporal scale matters. Meta-awareness seems to follow a specific trajectory:

- Weeks 1-4 (state level): During formal practice, practitioners transiently access meta-awareness. Outside practice, it vanishes.
- Weeks 4-12 (proto-trait): Meta-awareness begins to persist briefly outside practice. An emotional trigger still captures attention, but the person more quickly notices: "Oh, I'm caught; let me step back."
- Months 3-6 (trait emergence): Meta-awareness becomes semi-stable. The person notices emotional reactivity from a slightly disidentified position; the reactive loop is shortened.
- Years 1+ (integrated trait): Meta-awareness becomes the baseline. The person inhabits the witnessing space as their natural home; reactivity is rare.

For clinical trauma work, this trajectory suggests a specific protocol: intensive Witnessing-Space training (Level 2 in the 4-Level Model) during the acute treatment phase accelerates the move from state to trait. By weeks 8-12, meta-awareness begins to persist, providing the "operating system" that prevents relapse even as Mechanism 1-3 work continues (meaning-work, emotional regulation, narrative processing).

This is why we predict that H4 (mediation pathway: somatic → meaning → growth) is partially mediated by Witnessing-Space development. Witnessing-Space is the capacity that meaning-work produces; without it, meaning is fragile; with it, meaning is durable (see Section 6.1, Hypothesis 4).

3.4.8. Witnessing-Space as Meta-Mechanism: How Mechanism 4 Organizes Mechanisms 1-3

We can now articulate how Witnessing-Space functions as a meta-mechanism that stabilizes the entire system.

Mechanisms 1-3 operate at the content/process level:

- Mechanism 1 (Hierarchical Recalibration): Works on *what* the hierarchy predicts. Generates new meaning-priors. Expensive, requires belief-updating, vulnerable to falsification.
- Mechanism 2 (Emotional Criticality): Works on the *balance* between limbic subsystems. Oscillates between Papez (hope) and Yakovlev (caution). Dynamically unstable; can collapse into rigidity or dissociation.
- Mechanism 3 (Spatiotemporal Coherence): Works on *when* the system responds. Extends ACW through infra-slow oscillations. Supports narrative continuity.

Each mechanism alone is insufficient:

- Without Mechanism 4, Mechanism 1 (meaning) remains a brittle construction, vulnerable to contradiction. The patient recovers the narrative cognitively but remains existentially fragile. Any new adversity that falsifies the meaning-prior triggers re-traumatization.
- Without Mechanism 4, Mechanism 2 (emotional balance) oscillates but never settles. The limbic system yo-yos between extremes, creating the chaotic volatility familiar in unhealed trauma survivors.
- Without Mechanism 4, Mechanism 3 (temporal coherence) supports narrative but not wisdom. The person has a story with temporal continuity but no perspective on the story. They are still trapped in the narrative.

With Mechanism 4 (Witnessing-Space), all three mechanisms gain stability:

- Mechanism 1 operates within a container (Witnessing-Space) that is immune to contradiction. The meaning can be updated, revised, even dissolved, without the container collapsing. This is existential freedom.
- Mechanism 2 oscillates at criticality but doesn't destabilize, because the global gamma binding (Witnessing-Space) maintains integration. The person can feel intense emotions without fragmenting.

 doi:10.20944/preprints202602.1324.v1

- Mechanism 3 achieves not just narrative continuity but temporal wisdom. The extended ACW now encompasses not just the story-in-time but the space-in-which-the-story-occurs. The person is the story and the stage simultaneously.

Thus, the clinical formula becomes clear:

Level 0 (Somatic Stabilization) → Level 1 (Narrative Integration) → Level 2 (Mechanism 4: Witnessing-Space Development) → Level 3 (Deep Meaning Integration)

Not: Level 2 is added to 0-1.

But: Level 2 is the *foundation* that makes Level 3 possible. Without Mechanism 4 established, Level 3 work remains unstable.

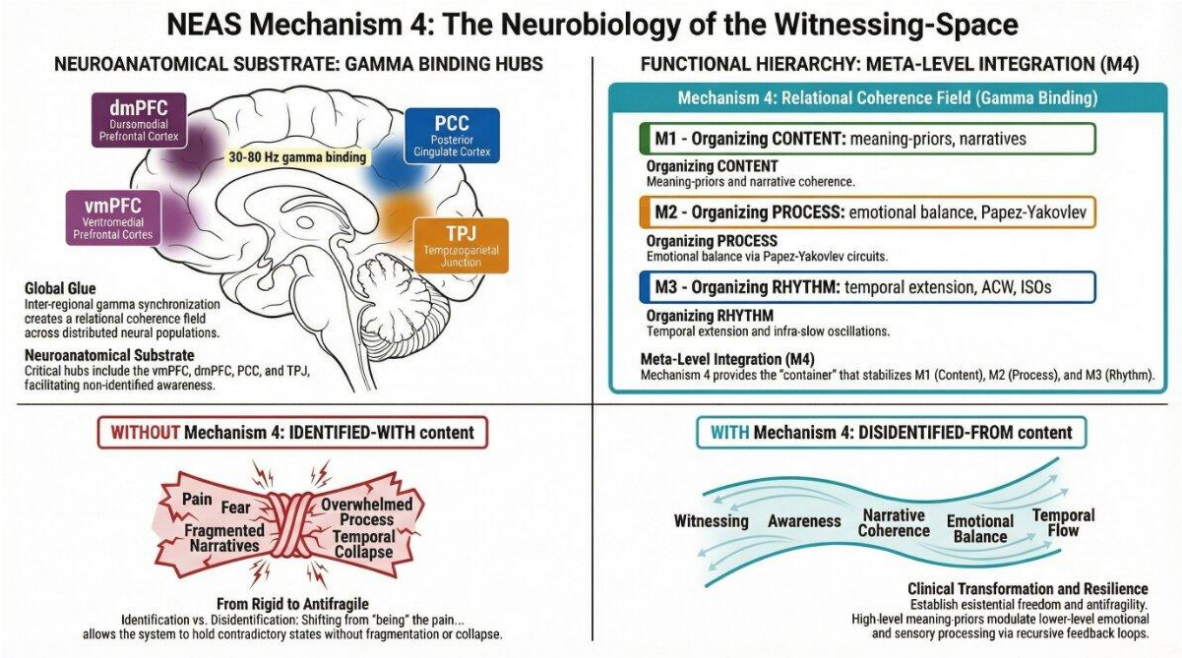

Figure 5. NEAS Mechanism 4: Proposed Neurobiology of Witnessing-Space.

Note. Left: Candidate gamma-synchrony network (30–80 Hz) among vmPFC, dmPFC, PCC, TPJ hypothesized to support *non-identified meta-awareness*. Right: Functional hierarchy—M1 organizes content (meaning/narratives), M2 process (emotion), M3 rhythm (ACW/ISOs)—all proposed to integrate *within M4 coherence field*. Without M4: identified/fragile (pain → fragmentation). With M4: disidentified/resilient (pain → antifragility).

Conceptual model only. Gamma-M4 linkage novel/speculative; empirical validation pending (Section 6).

Abbreviations: vmPFC, ventromedial prefrontal cortex; dmPFC, dorsomedial prefrontal cortex; PCC, posterior cingulate cortex; TPJ, temporo-parietal junction; ACW, autorelational window; ISO, infra-slow oscillation; M1–M4, Mechanisms 1–4.

3.4.9. Falsifiability and Measurement of Witnessing-Space

For Mechanism 4 to be a scientific hypothesis, it must be falsifiable and measurable.

Neurobiological markers of Witnessing-Space:

(1) Gamma-band synchronization: Increased global gamma power (30-80 Hz), particularly inter-regional coherence, measured via high-density EEG during rest and during Witnessing-Space meditation practice. Prediction: Gamma power increases with Witnessing-Space training; correlates with clinical improvement independent of symptom reduction alone.

(2) Autorelational Window (ACW) extension: Enhanced ACW measured via resting-state fMRI autocorrelation in vmPFC, as proposed in H1. Extended ACW is a structural correlate of Witnessing-Space development.

 doi:10.20944/preprints202602.1324.v1

(3) Default Mode Network (DMN) integration: Increased functional connectivity within DMN (particularly vmPFC ↔ PCC/RSC) and reduced anticorrelation with task- positive networks. Integrated DMN is characteristic of advanced meditators.

(4) Structural brain changes: Increased gray matter volume in self-referential regions (vmPFC, medial temporal lobe, posterior cingulate) and reduced amygdala volume, as documented in meditation research. Trainable via 12-week protocol.

Behavioral/subjective markers of Witnessing-Space:

(5) Meta-awareness scales: Self-report instruments measuring capacity to observe one's own thoughts and emotions (e.g., Philadelphia Mindfulness Scale, Five Facet Mindfulness Questionnaire). Prediction: Increases during treatment; correlates with gamma power and ACW.

(6) Equanimity and non-reactivity: Behavioral observation of response to emotional triggers; standardized stress tasks (e.g., cold-pressor test, Trier Social Stress Test) combined with cortisol measurement. Witnessing-Space development predicts reduced reactivity independent of meaning-prior changes.

(7) Durability of gains: Long-term follow-up (12 months) showing lower relapse rates in high-Witnessing-Space groups even when meaning-prior remains challenged. Tests whether Witnessing-Space is truly meta-stabilizing.

(8) Explicit stress-testing: Present trauma narrative or triggering stimulus; measure whether patient maintains Witnessing-Space perspective or regresses to identification with content. High Witnessing-Space capacity predicts maintenance of perspective.

Revised and expanded hypotheses:

These markers will be operationalized in revised hypotheses (see Section 6.1):

- H4 (revised): Somatic work → Witnessing-Space development (measured via gamma, ACW, meta-awareness) → Meaning integration & PTG (mediation pathway).
- H5 (new): Intensive Witnessing-Space training (Level 2) produces measurable gamma synchrony increase and ACW extension independent of meaning-content changes. Validates Mechanism 4 as distinct from Mechanisms 1-3.
- H6 (new): Meta-awareness (Witnessing-Space) predicts 12-month durability and relapse resistance independent of symptom severity at 24 weeks. Tests whether Witnessing-Space is truly meta-stabilizing.

3.4.10. Clinical Implications: Why Witnessing-Space Cannot Be Bypassed

The clinical implication is stark: Witnessing-Space cannot be treated as optional or peripheral to trauma recovery. It is the operating system without which Mechanisms 1-3 eventually fail.

We have all encountered trauma survivors who achieve substantial symptom reduction and narrative coherence yet remain existentially fragile. They reach the end of standard treatment—PE, CPT, or EMDR—with PCL-5 scores in the normal range, functional capacity restored, relationships repaired. And yet they report: "Something essential is still missing. I feel hollow."

This is the patient who lacks Witnessing-Space development. Their hierarchical recalibration (Mechanism 1) is intact—they have a new narrative. Their emotional balance (Mechanism 2) is functional—they can regulate. Their temporal coherence (Mechanism 3) is restored—they remember in connected sequences. But the container that holds all three is still fragile. Any challenge to the meaning-prior (loss, betrayal, or simply the mundane disappointments of life) triggers the whole structure to shake.

By contrast, trauma survivors who have developed robust Witnessing-Space can experience profound challenge—loss of meaning, emotional turbulence, narrative disruption—and remain fundamentally intact. They hold it all in the vast, unshakeable space of awareness. Their recovery is not brittle resilience (white- knuckle endurance) but antifragile resilience (growing stronger through adversity) (Frankl, 1946/2006; Taleb, 2012).

The clinical protocol reflects this understanding:

Level 0 (Weeks 1-4): Physiological stabilization. Make the nervous system safe.

 doi:10.20944/preprints202602.1324.v1

Level 1 (Weeks 4-12): Initial meaning-reconstruction. Build a coherent narrative framework within which the trauma makes some sense.

Level 2 (Weeks 8-24, concurrent with Levels 0-1 in later phase): Witnessing-Space cultivation. Teach the patient to access and stabilize the meta-aware perspective. Begin with structured meditation practice (5-15 minutes daily); progress to informal practice (recognizing witnessing space spontaneously throughout day); integrate with trauma processing so that even distressing content is held within Witnessing-Space.

Level 3 (Weeks 12-40, building on established Witnessing-Space): Deep meaning integration. Now that the operating system is stable, do sophisticated meaning-work. Existential questions, purpose-reconstruction, integration of mortality, revisioning of identity. This work is secure because it occurs within the container of Witnessing- Space, not in the fragile narrative alone.

This sequencing explains why purely cognitive approaches (CBT without contemplative grounding) plateau around 60% symptom reduction. The cognitive restructuring works on Mechanism 1, but without Mechanism 4 established, Mechanism 1 remains metabolically expensive and vulnerable. Conversely, purely contemplative approaches (meditation without trauma-specific work) can support Mechanism 4 but fail to address Mechanisms 1-3, leaving patients with spiritual insight but unintegrated trauma.

NEAS explicitly integrates all four mechanisms, in sequence, with Level 2 (Mechanism 4) as the gateway to genuine, durable recovery. This is the theoretical justification for the clinical model presented in Section 5 and the empirical validation planned in Section 6.

3.5. THE FOUR-MECHANISM INTEGRATION: HIERARCHICAL ORGANIZATION AND SYSTEM RE-COHERENCE

3.5.1. The Hierarchical Architecture: How Four Mechanisms Organize into a System

These four mechanisms are not isolated processes but aspects of a single, integrated system-level reorganization. However, they operate at different levels of the predictive hierarchy, and their integration follows a precise order—from foundational to meta-level.

The Hierarchical Schema:

At the BASE (Foundation): Level 0: Sensorimotor-Physiological Stabilization (prerequisite, not a mechanism per se, but necessary condition)

At CONTENT LEVEL (Mechanisms 1-3):

- Mechanism 1 (Highest semantic level): Hierarchical Recalibration via Meaning-Priors → Sends downward organizing signals (semantic content)
- Mechanism 2 (Emotional mediating level): Emotional Criticality via Limbic Meta-Regulation → Oscillates around the meaning-center, receiving top-down meaning-signals and reciprocally feeding back affective-somatic information
- Mechanism 3 (Temporal organizing level): Spatiotemporal Coherence via Neural Timescales → Governs *when* the system responds; extends and stabilizes rhythms throughout the hierarchy

At META-LEVEL (Mechanism 4):

- Mechanism 4 (Structural meta-organizing level): Witnessing-Space as Structural Meta-Stabilization → Does not contain or direct content, but provides the relational coherence field (via inter-regional gamma binding) that permits Mechanisms 1-3 to function without fragmentation

Key Principle: Vertical Causality

This architecture exemplifies the principle of "downward causation" (downward causality) in hierarchical systems (Northoff et al., 2020; Melloni et al., 2021). The top level (Mechanism 1: meaning-priors) sends organizing signals downward. But causation is not *only* downward. Reciprocal, upward causation also occurs:

- Somatic signals from the body (Level 0) propagate upward as prediction errors

 doi:10.20944/preprints202602.1324.v1

- Emotional signals from the limbic system (Mechanism 2) modulate whether meaning-priors are accepted or rejected
- Temporal coherence signals (Mechanism 3) determine whether the system can maintain hierarchical integration across time

This is not a simple cascade but a dynamic equilibrium in which each level both organizes lower levels and is constrained by them (Northoff et al., 2020; Friston, 2023).

Mechanism 4's Unique Role in the Hierarchy

Witnessing-Space occupies a paradoxical position: it is simultaneously outside the hierarchical cascade (as meta-observer, not part of content) and foundational to it (as the binding field that permits hierarchy to remain coherent).

Mechanism 4 does not participate in the top-down/bottom-up signal flow of content. It does not compete with Mechanism 1 for semantic authority, nor does it regulate emotional states like Mechanism 2, nor organize temporal sequences like Mechanism 3. Instead, it provides the relational infrastructure that permits this entire network to remain integrated.

Through inter-regional gamma synchronization (Singer's Binding by Synchrony), Witnessing-Space maintains global coherence of the hierarchical system even when individual components are in conflict or operating at maximum capacity (Mechanism 2 at criticality, Mechanism 3 stretched to its temporal limits, Mechanism 1 encountering contradictions) (Singer, 2021; Melloni et al., 2021).

3.5.2. Integration Sequence: Why Order Matters

While all four mechanisms are necessary for complete recovery, they cannot be simultaneously engaged. The sequence matters—both neurobiologically and clinically.

Phase 1 (Weeks 1-4): Foundation and Initial Recalibration

- Primary focus: Mechanisms 1 (new meaning) + 0 (physiological safety)
- Why this order: A nervous system in acute hyperarousal cannot effectively process meaning-work or emotional subtlety. The person is flooded with somatic prediction errors ("Danger! Threat!") that block access to higher processing.
- Clinical approach: Establish physical safety (secure environment, somatic regulation, medications if needed to reduce hyperarousal). Simultaneously, introduce preliminary meaning-work: "Why did this happen?" "What does it mean that I survived?" These questions activate Mechanism 1 in its most basic form.
- Neurobiological rationale: Somatic stabilization reduces the allostatatic load—the metabolic cost of maintaining defensive postures. This frees metabolic resources for higher-order processing. Simultaneously, meaning-prior reconstruction begins to recalibrate the hierarchical predictions from "Danger everywhere" to a more nuanced threat-assessment.

Phase 2 (Weeks 4-12): Emotional Balance at Criticality

- Expand: Mechanism 2 (emotional criticality + limbic balancing) emerges as explicit focus
- Why now: Once basic safety is established, the affective turbulence becomes apparent—the oscillation between Papez-driven hope ("I can recover") and Yakovlev- driven caution/despair ("But what if I can't?"). This oscillation is not pathological; it is the system's attempt to find balance.
- Clinical approach: Introduce techniques that support oscillation at criticality (somatic work, emotional processing, affect labeling). The goal is not to suppress the oscillation but to facilitate it—to help the person feel the full range of emotions without freezing in either extreme.
- Neurobiological rationale: Mechanisms 1-2 begin to settle into a dynamic equilibrium. Meaning-priors send downward organizing signals. The limbic system receives these and oscillates around the new meaning-center rather than being driven by raw threat signals. This is the beginning of emotional regulation through meaning.

Phase 3 (Weeks 8-16, concurrent with Phase 2): Temporal Coherence and Narrative Integration

- Integrate: Mechanism 3 (spatiotemporal coherence, narrative rhythms) becomes fully engaged

 doi:10.20944/preprints202602.1324.v1

- Why here: With some emotional stability achieved, the person can now engage in narrative work—the detailed reconstruction of trauma memory in a coherent sequence. This requires extended ACW (Mechanism 3) so that the past, present, and future aspects of the trauma narrative can be held simultaneously without fragmenting.
- Clinical approach: Trauma-focused exposure-based work (PE, CPT) is most effective here. The person recounts the trauma repeatedly in a safe context, allowing habituation and re-narration to occur. The rhythm of this work—saying the story again and again—strengthens the ISO-based temporal container that supports narrative coherence.
- Neurobiological rationale: Mechanisms 1-3 now operate in concert. Meaning organizes semantically (top-down). Emotions oscillate around this meaning-center (reciprocal causation). Temporal rhythms extend and stabilize, permitting narrative continuity. The hierarchical system is re-coherencing.

Phase 4 (Weeks 12-24, foundational for all later work): Witnessing-Space Cultivation and Meta-Stabilization

- Introduce: Mechanism 4 (Witnessing-Space, meta-awareness) as explicit and central focus
- Why critical: By week 12, Mechanisms 1-3 have reached a functional baseline. The person has new meaning, emotional balance, and narrative coherence. But the system remains vulnerable. A contradiction to the meaning, an emotional trigger, a temporal disruption—any of these can destabilize the fragile reconstruction.

Mechanism 4 is introduced not as a luxury or advanced technique, but as the foundational "operating system" that makes Mechanisms 1-3 durable. Without Mechanism 4, the person is one crisis away from relapse.

- Clinical approach: Introduce formal Witnessing-Space practice (meditation, mindfulness, contemplative presence). Start with 5-10 minutes daily. Teach the person to notice: "I am not the thoughts; I am the space in which thoughts arise." "I am not the emotions; I am aware of them." This is not dissociation (detachment from affect) but disidentification (awareness of affect from a non-identified position).

Simultaneously, integrate Witnessing-Space into trauma processing. During exposure work, encourage the person to hold the traumatic memory within Witnessing-Space rather than only processing it narratively. This creates a double integration: content is processed (Mechanisms 1-3) AND held in meta-awareness (Mechanism 4).

- Neurobiological rationale: Mechanism 4 (via inter-regional gamma synchronization) establishes the relational coherence field that permits Mechanisms 1-3 to remain integrated even under stress. The person develops what Davidson calls "meta-awareness as a trait"—not just the ability to witness in meditation, but baseline capacity to recognize triggers, emotions, and thoughts from a witnessing perspective.

By week 20-24, this transition from state to proto-trait begins. The person reports: "I can feel triggered, and I notice I'm triggered. I can feel despair, and I'm aware of it. It's still difficult, but something is watching it all. That something is untouched."

Phase 5 (Weeks 24-40, building on established Mechanism 4): Deep Meaning Integration and Existential Transformation

- Deepen: Level 3 (existential meaning-reconstruction) becomes possible and safe
- Why now: With Mechanism 4 established, the person can now engage in sophisticated meaning-work that questions and challenges identity itself. They can ask: "Who am I if my trauma doesn't define me?" "What is my true purpose?" "What does it mean to live after loss?" These are destabilizing questions—they threaten the meaning-structure built in Phase 1. But with Mechanism 4 stable, they don't fragment the system. They deepen it.
- Clinical approach: Logotherapy, existential therapy, spirituality integration. The person is invited to reconstruct meaning at the deepest level—not just "I can work and have relationships again" but "My trauma has opened me to dimensions of humanity I didn't know before" or "My

 doi:10.20944/preprints202602.1324.v1

suffering has taught me compassion I can offer to others" or "I am part of something larger than my individual survival" (Frankl, 1946/2006; Tedeschi & Calhoun, 2004).

- Neurobiological rationale: Mechanism 1 (meaning) undergoes transformation—not just new content but restructured at a meta-level. The person's meaning-priors now include not just "How do I survive?" but "Why does anything matter?" "What is my mortality teaching me?" These are questions that dissolve rigid meaning-structures and open to wider perspectives. Because Mechanism 4 is stable, this dissolution and opening does not trigger fragmentation; it triggers flourishing (Frankl, 1946/2006; Tedeschi & Calhoun, 2004).

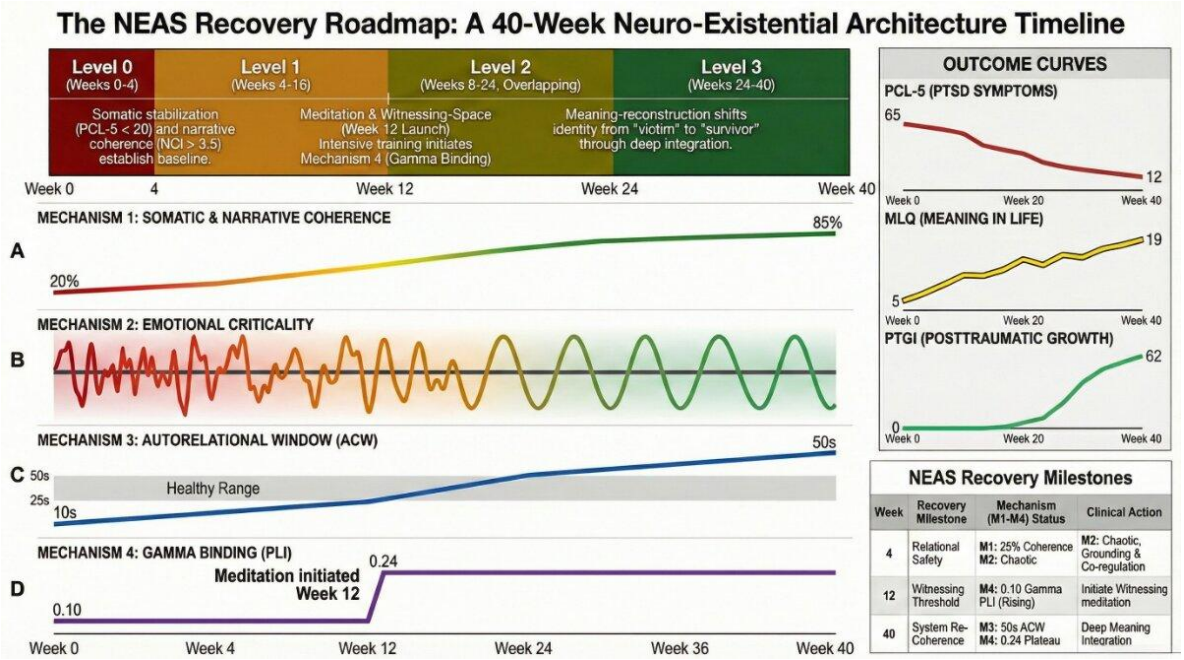

Figure 6. Predicted NEAS Mechanism Trajectories: 40-Week Theoretical Roadmap.

Note. Conceptual timeline depicting theoretically predicted evolution of four NEAS mechanisms and outcomes assuming model fidelity. Levels (top): L0 somatic (0–4w), L1 narrative (4–16w), L2 meaning (8–24w), L3 integration (24–40w). Mechanisms (lanes A–D): M1 coherence (20→85%), M2 criticality (chaos→equilibrium), M3 ACW (10→50s), M4 gamma PLI (0.10→0.25 post-meditation). Outcomes (right): Hypothetical PCL-5 decline, MLQ/PTGI rise.

Purely theoretical predictions; no empirical data. RCT (Section 6) tests if reality matches. Designed for clinician psychoeducation.

Abbreviations: M1–M4, Mechanisms 1–4; ACW, autorelational window; PLI, phase-locking index; PCL-5, PTSD Checklist; MLQ, Meaning in Life Questionnaire; PTGI, Posttraumatic Growth Inventory.

3.5.3. System Re-Coherence: The Neurobiological Outcome

The integration of all four mechanisms produces what we call system re-coherence— the restoration of the hierarchical predictive system to functional and flexible integration.

In acute trauma, the hierarchy is shattered:

- Level 0 (somatic): Hyperarousal, dissociation, dysregulation
- Mechanism 1 (meaning): Generative models fail; "It makes no sense; I cannot predict safety"
- Mechanism 2 (emotion): Limbic systems dysregulate; oscillation collapses into freeze or hyperactivity
- Mechanism 3 (time): ACW collapses; temporal continuity fractures
- Mechanism 4 (meta-awareness): Fragmentary gamma binding; no integrated witnessing; identity dissociates

With NEAS integration, the hierarchy re-organizes:

 doi:10.20944/preprints202602.1324.v1

- Level 0 (somatic): Nervous system returns to baseline arousal; body re-enters felt sense of safety
- Mechanism 1 (meaning): Hierarchical meaning-priors are reconstructed; new narratives organize predictions; the generative model recalibrates: "I was harmed, and I survived; this changes how I see myself and the world"
- Mechanism 2 (emotion): Limbic systems re-balance; Papez and Yakovlev oscillate around the new meaning-center; the person can feel hope and caution, grief and growth
- Mechanism 3 (time): ACW extends; neural timescales recover; the person can hold past, present, and future in a coherent narrative arc
- Mechanism 4 (meta-awareness): Inter-regional gamma binding solidifies; the witnessing space is stabilized; identity becomes both embodied AND disidentified; the person can be in their life AND observe their life

The result is what we call "antifragile resilience" (Taleb, 2012; Frankl, 1946/2006):

Not brittle resilience—white-knuckle survival, hypervigilance disguised as strength, where any contradiction or challenge triggers relapse. Rather, resilience that *grows* through adversity. The person who has integrated all four mechanisms develops what Frankl (1946/2006) calls "tragic optimism"—the capacity to maintain meaning even when facing loss, suffering, and mortality. This is not naive optimism (denying difficulty) but realistic hopefulness grounded in the non-shaking observation that meaning persists even through loss.

3.5.4. Why All Four Mechanisms Are Necessary

We can now articulate precisely why all four mechanisms are necessary, and why each alone is insufficient:

Mechanism 1 alone (Meaning-Work Only):

- Produces semantic recalibration and narrative coherence
- But meaning remains metabolically expensive and fragile
- When challenged (new trauma, loss, contradiction), the meaning-structure collapses
- Example: The patient who achieves new narrative ("I am a survivor") but fragments when that identity is challenged

Mechanism 2 alone (Emotional Regulation Only):

- Produces balance between hope and caution
- But without meaning-direction, emotional oscillation is directionless
- The person feels calmer but still lost ("I feel less afraid, but why am I living?")
- Example: The patient on SSRIs who is calmer but reports existential emptiness

Mechanism 3 alone (Temporal/Narrative Coherence Only):

- Produces extended ACW and sequential memory
- But narrative continuity without meta-awareness is entrapment
- The person can tell their story but cannot transcend it
- Example: The patient who has processed trauma memories but remains identified with trauma history

Mechanism 1 + 2 + 3 (Standard trauma therapy without Mechanism 4):

- Produces the classic outcome: symptom reduction, functional recovery, narrative integration
- BUT: The system remains fragile, vulnerable to relapse, existentially uncertain
- The person is "recovered" by external metrics but internally hollow
- Example: The patient with PCL-5 in normal range, employed, in relationships, but reporting "Something essential is still missing"

All Four Mechanisms (NEAS integrated):

- Meaning (Mech 1) provides direction
- Emotional balance (Mech 2) permits holding multiple affects
- Temporal coherence (Mech 3) creates continuity

 doi:10.20944/preprints202602.1324.v1

- Meta-awareness (Mech 4) provides the container that holds all three
- Result: Durable, flexible, wise resilience. Antifragility (Taleb, 2012; Frankl, 1946/2006)

3.5.5. The Neurobiological Basis of Meaning-Mediated Healing

We can now articulate the complete neurobiological basis of how meaning *stabilizes* the brain's architecture through all four mechanisms:

Downward causation (Meaning → Emotion → Time → Meta-Awareness):

Meaning-priors at the highest semantic level send downward-organizing signals to lower levels of the hierarchy. These signals recalibrate what the system predicts at all lower levels (Friston, 2010; Hohwy, 2013). A new meaning—"I survived; this changes who I am"—recalibrates predictions at the emotional level (Yakovlev no longer predicts constant danger) and at the temporal level (the future is no longer foreclosed). This top-down effect is Mechanism 1.

Emotional equilibrium at criticality (Mechanism 2):

As meaning-priors recalibrate, the limbic system transitions from dysregulation to critical balance. The Papez system (hope, agency, future-directed motivation) and the Yakovlev system (caution, past-referenced protection, reality-checking) begin to oscillate around the new meaning-center rather than swinging to extremes. This is Mechanism 2. The person can feel both grief and growth without fragmenting (Tucker & Luu, 2025; Porges, 2021).

Temporal and rhythmic re-organization (Mechanism 3):

As emotional balance stabilizes, neural timescales extend. The infra-slow oscillations (ISOs, 0.01-0.1 Hz) that were collapsed in trauma now re-emerge, creating a temporal container for the higher-frequency rhythms of thought and feeling. The autorelational window (ACW) extends as the brain learns to maintain correlation with its own prior states over longer durations. Narrative continuity becomes possible; the person can hold past, present, and future in a coherent arc (Northoff, 2014; Raichle & Snyder,2007).

But the crucial final step is not just managing these lower mechanisms better—it is establishing Mechanism 4, which provides the relational coherence field that permits all three to function without fragmentation. Through inter-regional gamma synchronization (Singer's Binding by Synchrony), the brain achieves global integration. The person is no longer identified with their thoughts, emotions, and narratives but aware of them from a witnessing position. This disidentification is not dissociation; it is wisdom. It permits flexibility: meaning can be updated, emotions can fluctuate, narratives can be revised—all without the system collapsing (Singer, 2021; Melloni et al., 2021).

Upward causation and reciprocal regulation:

Simultaneously, causation flows upward. Somatic signals from the body continuously inform the emotional system (interoceptive feedback). The emotional system feeds back to update meaning-priors (an emotion might say: "Wait, this meaning doesn't match how my body feels"). Temporal patterns provide constraints on what narratives are sustainable (a narrative that ignores temporal reality will eventually falsify). And meta-awareness (Mechanism 4) provides ongoing observation of whether the entire system is in coherence or fragmenting (Singer, 2021; Friston, 2023).

This is a dynamical system in genuine equilibrium—not rigid equilibrium (stuck) but dynamic equilibrium (flexible, responsive, learning). This is the state that permits authentic resilience and, ultimately, posttraumatic growth (Tedeschi & Calhoun, 2004; Frankl, 1946/2006).

3.5.6. From System Re-Coherence to Authentic Resilience: The Outcome

The integration of all four mechanisms produces what we call authentic resilience— resilience grounded in truth rather than defense.

Brittle resilience (typical outcome of standard trauma therapy without Mechanism 4):

- Symptom suppression masquerading as recovery
- Narrative reconstruction via willpower
- White-knuckle endurance ("I won't let this break me")
- Vulnerable to relapse when tested

 doi:10.20944/preprints202602.1324.v1

- Existentially uncertain ("Am I really okay?")

Authentic resilience (outcome of NEAS integration):

- Symptom transformation via meaning and acceptance
- Narrative wisdom (holding story and transcending it)
- Effortless presence (no longer fighting the past)
- Resilient through stress (grows stronger through adversity)
- Existentially clear ("Yes, I am okay, and life is okay, even with difficulty")

This difference is measurable neurobiologically—in ACW extension, gamma synchrony, DMN integration, and brain structural changes. It is also measurable clinically—in durability of gains, resistance to relapse, and capacity for posttraumatic growth (Tedeschi & Calhoun, 2004; Frankl, 2006; Leidig, 2026).

This is the neurobiological basis of meaning-mediated healing.

SECTION 4: OPERATIONALIZATION & MEASUREMENT

4.0. Introduction

Now that we have established the theoretical foundations (Section 2) and the three neurobiological mechanisms through which meaning stabilizes the traumatized brain (Section 3), we must operationalize meaning into measurable, clinically-useful dimensions that can be reliably assessed in both research and clinical contexts (Martela & Steger, 2016; Steger et al., 2006). Without operationalization, meaning remains abstract—philosophically interesting but clinically and scientifically intractable (Frankl, 1946/2006; Northoff, 2014).

The challenge is to avoid two pitfalls:

1. Over-reductionism: Reducing meaning to a single number or dimension, losing the richness and multifacetedness of the construct (Yalom, 2008)
2. Vague pluralism: Acknowledging multiple dimensions but offering no clear measurement strategy or clinical guidance (Tucker & Luu, 2025)

The NEAS approach navigates between these by identifying three core dimensions of meaning, each with specific neurobiological correlates, validated measurement instruments, and clear clinical markers of authenticity vs. defense (Leidig, 2026). This three-dimensional framework captures the essential phenomenological and neurobiological aspects of meaning while remaining operationally precise and clinically useful.

Multi-Method Measurement of NEAS Constructs

Measurement Level	Coherence (The Intelligible World) The subjective sense that life follows comprehensible patterns and causal logic rather than being chaotic.	Purpose (The Directed Life) The sense that life has a clear direction and that current actions aim toward valued future goals.	Significance (Inherent Worth) The deepest sense that one's existence has inherent dignity and independent of external achievement.
Self-Report	Narrative Coherence Index (NCI)	Meaning in Life Questionnaire (MLQ)	Existential Fulfillment Scale (EFS)
Behavioral	Life story coherence rating	Goal engagement & activity tracking	Self-compassion & resilience behaviors
Neurobiological	Predictive hierarchy integrity (fMRI)	Papez activation (fMRI, EEG)	Extended ACW & robust ISOs (neurophysiology)

Figure 7. Multi-Modal Measurement Matrix for NEAS Meaning Dimensions.

Note. Conceptual framework proposing convergent assessment of Coherence, Purpose, and Significance across self-report, behavioral, and neurobiological modalities. Self-report (top): NCI

 doi:10.20944/preprints202602.1324.v1

(world intelligibility), MLQ (direction), EFS (worth). Behavioral (middle): Narrative ratings, goal tracking, compassion behaviors. Neurobiological (bottom): fMRI hierarchy integrity (M1), Papez activation (M2), ACW/ISO (M3).

Proposed operationalization; convergent/neurobiological validity pending RCT validation (Section 6). Enables multi-method triangulation.

Abbreviations: NCI, Narrative Coherence Index; MLQ, Meaning in Life Questionnaire; EFS, Existential Fulfillment Scale; fMRI, functional MRI; EEG, electroencephalography; ACW, autorelational window; ISO, infra-slow oscillation; M1–M3, Mechanisms 1–3.

4.1. The Three-Level Operationalization of Meaning

Level 1: Coherence — The World is Intelligible

The first dimension of meaning is Coherence: the subjective sense that the world follows comprehensible patterns, that events have causal explanations, that one's experience makes sense (Bluck & Habermas, 2000; Steger & Frazier, 2005). Coherence is not about optimism or positivity; it is about intelligibility. The trauma survivor achieves coherence when she can narrate her experience—"This happened because of these causes. I understand how my trauma occurred. The world follows rules, and I can navigate them"—even if those rules are sometimes harsh (Frankl, 1946/2006; White & Epston, 1990).

Neurobiological substrate: Coherence depends on the integrity of the brain's predictive hierarchy, particularly the ability of higher regions (vmPFC, default mode network) to generate and maintain stable generative models that explain sensory input and reduce prediction error (Friston, 2010; Northoff, 2014). When the hierarchy is fragmented, the world feels incoherent, chaotic, unpredictable. When it re-integrates through meaning-reconstruction, coherence returns (Singer, 2021; Melloni et al., 2021).

Clinical markers of authentic coherence:

- Patient can construct a coherent narrative of her trauma (not fragmented, but also not denying)
- She can explain the causes (situational factors, perpetrator psychology, bad luck) without self-blame
- She acknowledges gaps or areas she doesn't understand, but experiences most of her life as coherent
- She can predict and navigate her environment with reasonable accuracy
- The narrative is flexible and can accommodate new information without rigidifying

Clinical markers of defensive/fragile coherence:

- Overly neat, simplistic narrative ("It happened, I moved on, I'm fine") that collapses under stress
- Excessive self-blame ("It was all my fault") or excessive externalization ("The world is pure evil")
- Rigid narrative that cannot accommodate new information or grief
- Implicit dissociation masked by intellectual coherence
- Narrative that breaks down when patient encounters real-world difficulty

Measurement instruments:

- Self-report: Narrative Coherence Index (NCI; Bluck & Habermas, 2000; α = .78–.85)—patient rates intelligibility of life story on validated 5-point scale. Internal consistency reliable; test-retest stability r = .72
- Clinician-rated: Coherence Rating Scale (0–10 developed for NEAS)—clinician assesses coherence of patient's narrative based on interview (ICC = .81 inter-rater reliability)
- Behavioral: Trajectory in therapy—does patient's narrative become more integrated over time? Can patient articulate timeline of life events with minimal contradiction?

Level 2: Purpose — Life Has Direction

The second dimension is Purpose: the sense that life has direction, that one's actions aim toward something that matters, that the future holds meaningful possibility (Steger et al., 2006; Martela & Steger, 2016). Purpose is forward-looking and intentional. A person with low purpose reports: "I don't have goals that matter. I get up and go through the motions, but I'm not moving toward anything."

 doi:10.20944/preprints202602.1324.v1

A person with purpose reports: "My life is oriented toward helping others, creative work, family, justice, spiritual development, personal growth. This gives my daily actions meaning" (Frankl, 1946/2006; Tedeschi & Calhoun, 2004).

Neurobiological substrate: Purpose engages the Papez system and forward-projecting capability of vmPFC and hippocampus, which generate predictions about valued futures and organize behavior toward those futures (Aston-Jones & Cohen, 2005; Tucker & Luu, 2025). It also engages the dopaminergic reward system, which encodes the subjective value and motivational pull of goals (Nutt et al., 2015). Trauma often damages both: the person cannot imagine a valued future, and the dopaminergic system is dysregulated, making even pre-trauma goals feel unmotivating (van der Kolk, 2014). Recovery of purpose requires reactivation of these forward-projecting systems through meaning-work.

Clinical markers of authentic purpose:

- Patient can articulate 1–3 valued directions for her life (not vague, but specific)
- Goals are aligned with her own values, not imposed by others or by trauma-driven urgency
- She is actively engaged (even if modestly) in working toward these goals
- She reports that these goals are meaningfully her own, not empty obligations or compulsions
- Goals are flexible and can evolve; not rigidly fixed or desperate
- Patient shows behavioral activation toward stated goals; not just intellectually aware of them

Clinical markers of defensive/fragile purpose:

- "Driven" quality where person pursues goals compulsively to avoid grief or emptiness
- Grandiose goals ("I'll become famous, then I'll be worthy") that collapse under reality testing
- Goals focused primarily on proving oneself after trauma ("I'll show everyone I'm strong") rather than intrinsic values
- Absence of intrinsic motivation; all goals feel empty or obligatory
- Rapid goal-switching or abandonment; difficulty sustaining effort toward stated purposes
- Goals that serve avoidance of pain rather than approach toward meaning

Measurement instruments:

- Self-report: Meaning in Life Questionnaire (MLQ; Steger et al., 2006; α = .82–.90)—assesses both presence of meaning and search for meaning in life. Two-factor structure; both factors predict well-being at 5-year follow-up
- Behavioral: Behavioral Activation Log—tracking engagement in valued activities per week (ICC = .85); percent of days patient engages in at least one valued activity
- Clinician observation: Patient engagement in therapeutic work toward valued direction; frequency of goal-directed conversation; behavioral follow-through
- Functional measure: Return-to-work/study status; engagement in volunteer work or creative pursuits aligned with stated values

Level 3: Significance — Existence Has Inherent Worth

The third and deepest dimension is Significance: the sense that one's existence has inherent dignity and value, independent of achievement, relational success, or instrumental productivity (Yalom, 2008; Tedeschi & Calhoun, 2004). Significance asks: "Am I worthy simply by existing?" not "What have I accomplished?" A person with low significance feels worthless, undeserving of care or attention, dispensable. A person with significance feels: "I am valuable. My life matters. My presence in the world is meaningful, regardless of what I produce or achieve" (Frankl, 1946/2006).

Neurobiological substrate: Significance depends on the integration of dmPFC (self-worth representation) with long timescale neural oscillations (ACW and ISOs) that create a stable, continuous sense of self-value that persists across time and circumstances (Northoff, 2014; Northoff et al., 2020; Keilholz et al., 2013). It involves the stabilization of the default mode network into a coherent, self-affirming state that is somewhat resistant to momentary mood or circumstance. Trauma often collapses this sense; the person feels "broken at the core," unworthy of existence (van der Kolk, 2014). The neurobiological basis of significance is the extension and stabilization of the

 doi:10.20944/preprints202602.1324.v1

ACW combined with robust ISO functioning—a temporal coherence and rhythmic groundedness that supports self-worth.

Clinical markers of authentic significance:

- Patient reports a baseline sense of personal worth that persists even when she's struggling or failing
- She can distinguish between "I made a mistake" (action evaluation) and "I am a mistake" (identity/worth evaluation)
- She demonstrates self-compassion—treating herself with kindness even when struggling
- She can receive care and support without feeling like she's "burdening" others
- She maintains this sense even under stress; it's relatively stable and resilient
- She can experience sadness or grief without this undermining her fundamental sense of worthiness

Clinical markers of defensive/fragile significance:

- Contingent self-worth ("I'm only valuable if I'm productive/perfect/helping others")
- Grandiose self-worth masking deep unworthiness ("I'm special and above others")
- False humility ("I have no worth, that's fine") as cover for shame
- Vulnerability to mood shifts that destroy sense of worth; brittle self-esteem
- Difficulty receiving any care without guilt or suspicion
- Self-harm or self-sabotage patterns suggesting disbelief in personal worth

Measurement instruments:

- Self-report: Posttraumatic Growth Inventory–Self Transcendence subscale (PTGI-ST; Tedeschi & Calhoun, 2004; α = .90) assesses spiritual growth and sense of significance. Validated across trauma populations; predicts long-term recovery
- Self-report: Existential Fulfillment Scale (EFS; Längle et al., 2003; α = .88)—assesses felt sense of meaning, life worth, and existential fulfillment. Austrian-developed; validated cross-culturally
- Neurobiological: Autorelational Window (ACW) extension and Infra-Slow Oscillation (ISO) stabilization via resting-state fMRI/EEG in subsample of research participants
- Behavioral: Capacity to sustain valued engagement during difficulty; ability to recover sense of worth after setback; self-care behaviors indicating respect for own wellbeing
- Implicit measure: Implicit Association Test (IAT) comparing self + worthwhile with self + worthless (if time/resources permit)

4.2. Authenticity vs. Defensiveness: Distinguishing Genuine from Fragile Meaning

A critical clinical challenge is distinguishing authentic meaning (integrated, flexible, grounded in reality) from defensive meaning (rigid, denial-based, fragile under stress) (Frankl, 1946/2006; Steger & Frazier, 2005). A patient can report high meaning scores while actually operating from fragile defensive structures that will collapse under stress (Leidig, 2026). This is why clinician judgment, behavioral observation, and stress-testing are essential complements to self-report measures.

Markers of Authentic Meaning:

1. Integrates grief: The person acknowledges loss, pain, and ongoing vulnerability while maintaining meaning. Not "trauma was good for me" but "trauma was terrible, and I'm learning from it."
2. Flexible: The meaning-framework can accommodate new information, ambiguity, and change without rigidifying
3. Grounded in reality: Goals are realistic; self-assessment is honest (not grandiose or self-deprecating)
4. Non-defensive: The person does not need to minimize the trauma or overstate growth to maintain meaning
5. Embodied: Meaning is felt in the body, lived daily, not just intellectually held
6. Relational: Person can share meaning-framework vulnerably with others; not isolated or superior
7. Resilient: Meaning persists under stress; not fragile or dependent on external validation

 doi:10.20944/preprints202602.1324.v1

Markers of Defensive Meaning:

1. Denies grief: "I'm healed. I don't feel sad anymore." (Watch for emotional flatness or collapse under stress)
2. Rigid: Single narrative that cannot adapt; defensive when questioned or challenged
3. Grandiose: "The trauma made me enlightened" or "I'm stronger than everyone who hasn't suffered" (manic defense)
4. Disembodied: High MLQ/PTGI scores but PCL-5 unchanged; body still frozen with fear (dissociated meaning)
5. Depressive pseudo-acceptance: "Life has no meaning; that's okay" (resignation masquerading as acceptance)
6. Spiritual bypassing: Meaning becomes escape from embodied healing; spiritual language replaces integration
7. Fragile under stress: Meaning-framework collapses when patient encounters difficulty; reveals underlying despair

Clinical strategy for distinguishing authentic from defensive: Use stress-testing. Does the meaning-framework hold when the person encounters difficulty? If it collapses (depression, rage, fragmentation, dissociation), it was defensive. If it flexes but remains stable, if the person can acknowledge difficulty while maintaining core sense of meaning, it's authentic (Tucker & Luu, 2025; Leidig, 2026). This is done through:

- Asking patient about recent challenges: "Did your sense of meaning shift? How?"
- Observing affect congruence: Does narrative match emotional tone?
- Tracking behavioral persistence: Does patient maintain valued activities when difficulty arises?
- Longitudinal observation: Does meaning deepen or remain stagnant over months?

4.3. Multimethod Assessment Strategy

The NEAS recommends a multimethod approach to meaning assessment, combining self-report, behavioral, neurobiological, and clinician-observation measures. This triangulation provides comprehensive assessment and guards against mono-method bias:

Self-Report Instruments:

- Meaning in Life Questionnaire (MLQ; Steger et al., 2006; α .82–.90)
- Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 2004; α .90)
- Existential Fulfillment Scale (EFS; Längle et al., 2003; α .88)
- Life Engagement Test (Engagement Scale; Scheier et al., 2006; α .78)
- Narrative Coherence Index (NCI; Bluck & Habermas, 2000; α .78–.85)

Behavioral Measures:

- Behavioral Activation Log (tracking valued activity engagement; ICC > .85)
- Goal-achievement tracking relative to patient-identified valued directions
- Narrative quality and coherence in therapy sessions (rated by clinician)
- Capacity to sustain engagement during difficulty
- Return-to-work/school/volunteer status

Neurobiological Measures (research subsample):

- Autorelational Window (ACW) extension via resting-state fMRI (vmPFC correlation with lagged activity)
- Infra-Slow Oscillation (ISO) power and stability via resting-state fMRI or EEG
- Default Mode Network connectivity strength (dmPFC-PCC-Hippocampus)

 doi:10.20944/preprints202602.1324.v1

- Heart rate variability (HRV) as peripheral correlate of nervous system integration

Clinician Rating:

- 0–10 Coherence Scale (narrative integration, flexibility)
- Authenticity vs. Defensiveness assessment based on clinical judgment and stress-testing
- Integration across dimensions (does patient have all three, or is one missing?)
- Clinician Coherence Rating (ICC = .81 inter-rater reliability)

Together, these measures provide a comprehensive, multi-level assessment of meaning that captures self-report, behavior, neurobiology, and clinician observation (Martela & Steger, 2016; Northoff, 2014). This multi-method approach is more robust than any single measure and provides clinical richness that single-measure approaches cannot achieve.

4.4. Cultural Considerations and Limitations

The NEAS framework is grounded in Western neuroscience and Western existential philosophy. It is important to acknowledge that meaning is culturally constructed and varies significantly across cultural contexts (Frankl, 1946/2006; Berman & Cohen, 2008). Meaning-making is not uniform across human cultures; it reflects values, worldviews, and priorities that vary by culture, spirituality, and individual difference.

Western-centric biases in the framework:

1. Emphasis on individual autonomy and self-actualization (vs. collective harmony in many Asian, African, Indigenous cultures where meaning is relational and community-based)
2. Narrative coherence as gold standard (vs. more cyclical, non-linear meaning-making in other traditions; Indigenous time-concepts may be circular rather than linear)
3. Assumption that meaning-searching and -making is healthy (vs. traditions emphasizing acceptance/surrender over active meaning-construction)
4. Neurobiological measurements privilege cortical, DMN-based processing (vs. somatic, embodied, kinesthetic meaning-making in non-Western traditions; some cultures emphasize heart-knowing or gut-knowing)
5. Emphasis on verbal narrative (vs. cultures emphasizing embodied, artistic, or spiritual expression of meaning)

Recommendations for cultural adaptation:

1. Assess the patient's own cultural framework for meaning before imposing the NEAS framework
2. Integrate culturally-specific meaning-making practices (ancestral connection, spiritual traditions, community-based values, seasonal/cyclical meaning)
3. Recognize that some cultures prioritize community/collective meaning over individual significance; meaning may be found in fulfilling family, community, or spiritual roles rather than individual self-actualization
4. Allow flexibility in how meaning is articulated and measured; not all meaning fits the three-dimension model equally
5. Validate non-Western meaning-making approaches equally with Western ones; recognize epistemic pluralism
6. Include cultural brokers/translators in assessment and treatment planning where possible

The goal is cultural humility: using the NEAS as a framework while respecting that meaning is culturally embedded and must be co-constructed with each patient in their own cultural context (Berman & Cohen, 2008; Tedeschi & Calhoun, 2004). The framework should serve patients, not constrain them within Western assumptions about what meaning "should" look like.

 doi:10.20944/preprints202602.1324.v1

SECTION 5: CLINICAL IMPLICATIONS

5.0. Introduction

Section 4 operationalized meaning into measurable dimensions with validated instruments. Now we translate this operationalization into clinical action—a four-level therapeutic architecture that sequences intervention based on patient profile and trauma severity (Leidig, 2026). The NEAS clinical model specifies not only what to address (all four levels) but also when and how to address them (three sequencing models responsive to patient profile and clinical presentation).

The model is grounded in trauma-informed principles: stabilization before processing, window of tolerance before expansion, relational safety as foundation (van der Kolk, 2014; Porges, 2021). But it extends beyond the standard three-level model to explicitly integrate existential meaning as a fourth, non-optional level that addresses the existential dimension of trauma and resilience (Cloitre, 2021; Ford & Courtois, 2014).

5.1. The Four-Level Therapeutic Architecture

The NEAS proposes a hierarchical four-level model where each level builds on the previous but addresses a distinct neurobiological and existential dimension of trauma recovery:

Level −1: Relational Safety (Foundational, Ongoing Throughout Treatment)

Trauma is fundamentally a rupture in safety and trust, often involving betrayal by another person or by the world as safe (Briere & Scott, 2015). Thus, the very foundation of healing is the restoration of relational safety—the experience of being present with another person (the therapist) in a way that is consistent, attuned, boundaried, and trustworthy (van der Kolk, 2014; Schore, 2001).

Neurobiological target: Ventral vagal activation (through polyvagal mechanisms; Porges, 2021), implying safety signaling from the therapist's own regulated nervous system to the patient's dysregulated nervous system (Dana, 2018). When a therapist is regulated and attuned, the patient's brainstem registers safety and begins gradual downregulation.

Primary techniques:

- Consistent therapeutic presence and reliability (never canceling, being on time, stable demeanor)
- Attuned responsiveness to patient's window of tolerance (not pushing beyond capacity, noticing dysregulation signals)
- Transparent communication about therapeutic process (explaining what we're doing, why, and how)
- Clear, consistent boundaries (confidentiality, appropriate emotional distance, therapist self-disclosure only when clinically indicated)
- Therapist's own nervous system regulation and co-regulation (the therapist's presence itself is therapeutic; requires therapist self-awareness and personal therapy/supervision)
- Validation of patient's experience and emotional responses (communicating that feelings are understandable given what occurred)

Key instruments:

- Working Alliance Inventory–Short Form (WAI-SF; Horvath et al., 2011); cutoff >200 indicates strong alliance (α = .91); predicts treatment outcomes across modalities
- Session Rating Scale (SRS; Duncan et al., 2003); brief 4-item measure assessing therapeutic relationship each session; used for session-by-session feedback
- Therapist self-assessment of own regulation and attunement (personal practice: meditation, yoga, somatic work; supervision with feedback on attunement)

Milestones:

- Consistent therapeutic relationship across sessions (no missed appointments, reliable therapist presence)

 doi:10.20944/preprints202602.1324.v1

- Patient demonstrates decreasing hypervigilance toward therapist (less scanning for danger, more eye contact, more verbal sharing)
- Patient can articulate what safety with therapist feels like ("You listen without judgment. You don't try to fix me. I trust you.")
- No significant ruptures or therapeutic impasse; if ruptures occur, they are repaired within session
- Patient reports feeling safe enough to disclose trauma material

Level 0: Sensorimotor-Physiological Stabilization (8–16 weeks, foundational alongside Level −1)

Once relational safety is established, the next level is nervous system regulation—helping the traumatized nervous system downregulate from dysregulation (hyperarousal, freeze, dissociation) into the window of tolerance—the optimal zone where the person is neither overwhelmed nor shut down (van der Kolk, 2014; Porges, 2021).

Neurobiological target: Restoration of vagal tone, parasympathetic dominance, reduction of amygdala threat-detection reactivity, reactivation of brainstem and lower limbic parasympathetic pathways (Dana, 2018; Levine, 2015). The goal is to restore the nervous system's capacity to downregulate from chronic dysregulation toward homeostasis.

Primary techniques:

- Somatic Experiencing (Levine, 2015)—pendulation between trauma-associated sensation and resource-associated sensation; gentle attention to bodily sensations with gradual exploration of trauma-related frozen responses
- Polyvagal-informed nervous system regulation (Porges, 2021; Dana, 2018)—using vagal brake restoration through specific techniques (humming, social engagement, proprioceptive input)
- Breathwork (box breathing, extended exhale) to activate parasympathetic nervous system
- Movement and discharge work to help body complete interrupted defensive responses
- Grounding and self-soothing techniques (5-senses grounding, progressive muscle relaxation, temperature shifts)
- Titration (small doses of processing, not flooding) to stay within window of tolerance
- Pendulation (shifting attention between dysregulated and resourced states) to build capacity

Key instruments:

- PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013); α = .94; goal: reduction from acute crisis (>50) to baseline (≤20); measured at baseline, 8 weeks, 16 weeks
- Dissociation Experiences Scale (DES; Bernstein & Putnam, 1986); α = .93; goal: <15 (normal range); measures depersonalization, derealization, dissociative amnesia
- Heart Rate Variability (HRV); vagal tone improvement (increasing HRV ratio); baseline to week 8 improvement trajectory
- Subjective Units of Distress (SUDS; 0–100 scale); goal: at rest <20; during trauma recall <60 (vs. baseline 80–100)
- Window of Tolerance Assessment: clinician observation of patient's capacity to engage in conversation without dissociation or hyperarousal

Milestones:

- PCL-5 reduction from acute crisis (e.g., 55) to moderate (e.g., 30–40) by week 8; continued reduction to <20 by week 16
- Patient can self-regulate using taught skills (breathing, grounding, somatic awareness)
- DES score <20 (normal dissociation range); patient reports decreased depersonalization/derealization
- Patient reports greater sense of bodily safety ("My body feels less like an enemy"; "I can notice sensations without panicking")
- Window of tolerance expanded (can tolerate more emotional intensity without dysregulation; session duration extended without shutdown)
- Sleep and appetite improvement (parasympathetic activation supports basic physiological restoration)

 doi:10.20944/preprints202602.1324.v1

- Reduced startle response and hypervigilance (amygdalar sensitivity decreases)

Critical Note: This level is typically addressed before or concurrent with Level 1, not after (Ford & Courtois, 2014; Levine, 2015). However, it does not require completion before moving to Level 1 in some patients; there is often productive overlap.

Level 1: Narrative-Autobiographical Coherence (12–24 weeks, overlaps with Levels 0–2)

Once the nervous system has some stability and the window of tolerance has expanded, the patient can engage in narrative work—reconstructing a coherent life story in which the trauma is integrated rather than encapsulated or denied (White & Epston, 1990; Ecker et al., 2012).

Neurobiological target: vmPFC-Hippocampus integration, reactivation of autobiographical memory systems, extension of autorelational window (ACW), construction of coherent generative models that can accommodate the trauma within a larger life narrative (Raichle et al., 2001; Northoff, 2014).

Primary techniques:

- Trauma-Focused Cognitive-Behavioral Therapy (TF-CBT; Resick et al., 2016)—graduated exposure to trauma memories plus cognitive processing of trauma-related thoughts ("I deserved it," "The world is all dangerous")
- Cognitive Processing Therapy (CPT; Resick et al., 2016)—structured processing of trauma impact on beliefs about safety, trust, control, esteem, and intimacy
- Narrative Therapy (White & Epston, 1990)—externalizing the problem, re-authoring personal narratives, identifying unique outcomes
- Internal Family Systems (IFS; Schwartz, 1997)—working with dissociated parts as internal subsystems with their own perspectives and protective roles
- Life Timeline work—placing trauma in context of full life narrative; distinguishing pre-trauma self, trauma period, and post-trauma growth

Key instruments:

- PCL-5 (continued monitoring; goal: further reduction toward ≤15–20 range; increased from baseline)
- Narrative Coherence Index (NCI; Bluck & Habermas, 2000); α = .78–.85; goal: >3.5 on 5-point scale; captures narrative integration
- Clinician Coherence Rating (0–10); goal: ≥7/10; clinician judges degree of narrative coherence, flexibility, integration
- PTGI (Posttraumatic Growth Inventory; Tedeschi & Calhoun, 2004); α = .90; tracking positive changes alongside trauma integration; goal: >40 total
- Behavioral observations: Can patient discuss trauma without overwhelming fragmentation? Does she show grief alongside coherence?

Milestones:

- Patient can narrate trauma without overwhelming fragmentation, dissociation, or dysregulation
- Coherent life story that integrates (not denies) trauma; can place trauma in context of full life ("The abuse happened from ages 7–14. Before that I was a normal kid. It ended when I told my teacher. Since then I've been rebuilding.")
- Shift from victim to survivor identity: "The trauma happened in my life" (vs. "I am a trauma victim"; vs. "The trauma made me who I am"); integration as neither defining nor dismissed
- Emergence of posttraumatic growth themes: "I understand suffering now." "I have more compassion." "I value my relationships more." (reflected in PTGI increase and spontaneous narrative)
- PCL-5 further reduction toward <20
- Behavioral reengagement in previously valued activities (returning to hobbies, relationships, social connection)

Level 2: Existential Meaning-Reconstruction (24+ weeks, open-ended, overlaps with Level 1)

The deepest and most sustained level is reconstruction of existential meaning—deep therapeutic engagement with the fundamental questions of why life is worth living, what constitutes authentic

 doi:10.20944/preprints202602.1324.v1

purpose and direction, how one's existence acquires inherent dignity and significance independent of achievement (Frankl, 1946/2006; Yalom, 2008; Breitbart et al., 2015).

Neurobiological target: Stabilization and integration of the entire default mode network (vmPFC-PCC-Hipp-temporal), extension of ACW to longest timescales (minutes to hours or beyond), stabilization of infra-slow oscillations (ISOs) at criticality (Northoff, 2014; Keilholz et al., 2013). Additionally, Papez-Yakovlev balance achieving dynamic criticality, permitting oscillation between hope and realism without dysregulation (Tucker & Luu, 2025).

Primary techniques:

- Logotherapy (Frankl, 1946/2006)—guided search for meaning in even the most difficult circumstances; exploring "Why should I live?" and finding personalized answers
- Meaning-Centered Group Psychotherapy (MCGP; Breitbart et al., 2015)—collective exploration of meaning with fellow survivors; community-based meaning-making
- Contemplative practice (meditation, mindfulness, prayer—adapted to patient's own spiritual/secular framework; not imposing therapist's spirituality)
- Legacy work—articulating what one wants to pass on to future generations, what mark one wants to leave in the world
- Values clarification and life direction alignment—identifying core values and aligning daily life with these values
- Existential psychotherapy (Yalom, 2008)—deep exploration of freedom (responsibility for choices), responsibility (authoring one's life), finitude (mortality and urgency), and isolation (ultimate aloneness and need for connection)
- Spiritual/philosophical exploration (adapted to patient's framework)—engaging questions of transcendence, purpose, sacred, divine (or secular equivalent)

Key instruments:

- Meaning in Life Questionnaire (MLQ; Steger et al., 2006); α = .82–.90; goal: ≥5/7 (indicating presence of meaning, not just search)
- PTGI–Spiritual Change subscale (α = .90); tracking spiritual/existential growth; goal: ≥15/20 on subscale
- Existential Fulfillment Scale (EFS; Längle et al., 2003); α = .88; goal: ≥4/5 (high existential fulfillment)
- ACW and ISO measures (resting-state neuroimaging in research subsample); goal: extension to pre-trauma baseline or beyond; ISO power/stability improvement
- Clinical observation: Does patient articulate coherent, flexible, embodied meaning-framework? Is meaning lived, not just intellectualized?
- Life satisfaction (Satisfaction with Life Scale; Diener et al., 1985); goal: ≥25/35 (above midpoint)

Milestones:

- Patient articulates clear sense of life purpose/direction that is felt as meaningful; not vague or imposed
- Purpose is owned, not imposed; flexible but stable; resistant to momentary mood shifts
- Significance (sense of inherent self-worth) is resilient; patient maintains sense of worthiness even during difficulty
- Meaning-framework holds under stress (stress-testing); when patient encounters setback, she can return to meaning rather than collapsing into despair
- Capacity for posttraumatic growth demonstrated: Patient shows greater compassion, clearer values, existential maturity, spiritual deepening
- ACW extended; ISOs stabilized neurobiologically (in research subsample)
- Patient reports life is "worth living" (not just "I'm not suicidal"; but actively affirming life value); future-oriented hope
- Behavioral sustainability: Patient maintains valued pursuits over months; not dependent on external reinforcement

 doi:10.20944/preprints202602.1324.v1

5.2. Three Sequencing Models: Responsive to Patient Profile

Not all patients move through four levels in the same sequence. The NEAS proposes three evidence-responsive models, each optimized for different patient profiles and trauma severity (Leidig, 2026; Ford & Courtois, 2014). Clinicians should select the model that best matches the patient's baseline presentation.

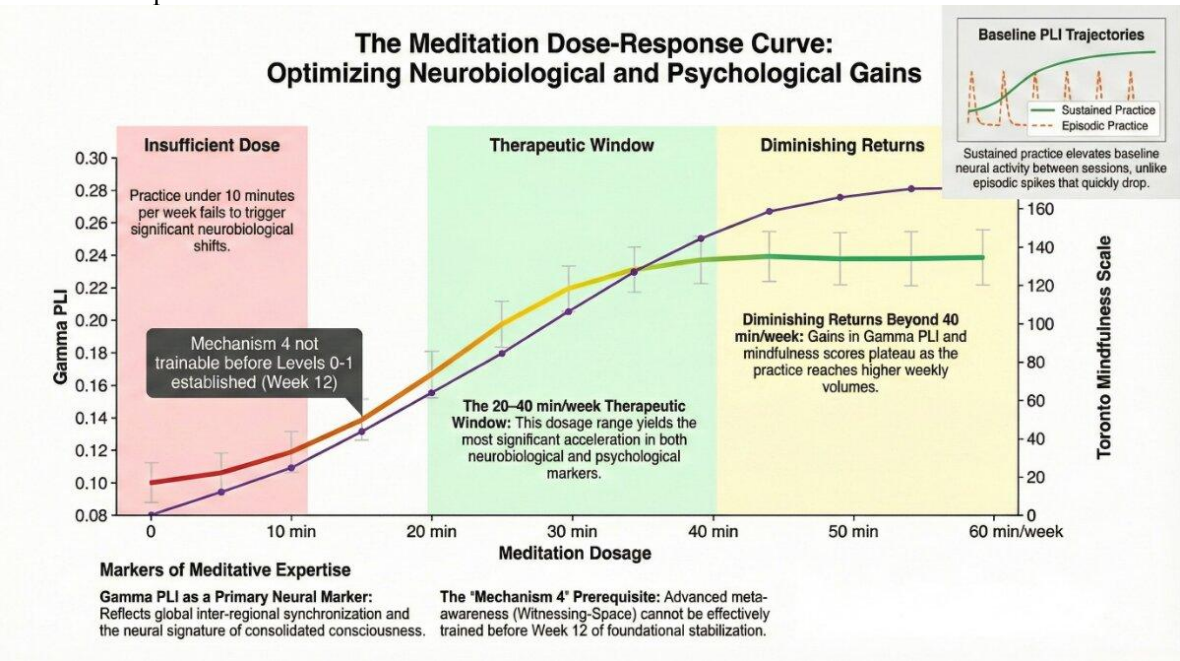

Figure 8. Proposed Meditation Dose-Response for Mechanism 4 (Gamma PLI) Development.

Note. Hypothetical nonlinear relationship between contemplative practice dosage and M4 markers. Primary curve (Gamma PLI): 0–10 min/week minimal; 10–40 min/week therapeutic window (steep gains); >40 min/week diminishing returns. TMS parallels PLI as behavioral proxy. Episodic vs. sustained practice differentiates state vs. trait effects. Clinical initiation post-Level 1 (Week 12+).

Theoretical model only—no empirical data. RCT (Section 6) tests predictions.

Abbreviations: M4, Mechanism 4; PLI, phase-locking index; TMS, Toronto Mindfulness Scale.

MODEL A: SEQUENTIAL (High PTSD, Existential Compromise)

Patient profile:

- PCL-5 >40 (high symptom severity)
- DES >20 (significant dissociation)
- Acute dissociation, fragmentation, depersonalization
- Existential stability baseline compromised (MLQ <3/7, suicidal ideation present)
- Functional impairment (unable to work, relationships significantly disrupted)

Sequence: Safety (−1) → Stabilization (0) → Narrative (1) → Meaning (2)

Rationale: Patient in acute neurobiological crisis; capacity for meaning-work is limited until nervous system stabilizes and existential crisis is addressed. Foundation-first approach. Each level must substantially stabilize before proceeding to next. Patient needs to feel bodily safe and cognitively coherent before existential meaning-work is developmentally appropriate.

Timeline: 24–36 weeks total

- Weeks 1–2: Establish safety, assess for safety (suicide risk, self-harm), begin somatic grounding
- Weeks 3–8: Continue relational safety development; focus on sensorimotor stabilization (PCL-5 reduction, dissociation decrease)
- Weeks 8–16: Narrative coherence work begins; symptoms continue to improve
- Weeks 16–36: Existential meaning-reconstruction; patient has foundation to engage with "Why live?" in deeper way

 doi:10.20944/preprints202602.1324.v1

Key milestones:

- Weeks 1–2: WAI >200 (safety established); suicide risk assessment and safety plan in place; no active self-harm
- Weeks 3–8: PCL-5 reduction 40→25 (substantial symptom decrease), DES <15 (normal dissociation), SUDS <30 at rest (reduced baseline arousal)
- Weeks 8–16: NCI 2→3.5 (narrative becomes more coherent), coherent narrative emerges with trauma integrated
- Weeks 16–36: MLQ 2→5+ (meaning increases), EFS improvement, extended ACW, patient reports life is worth living

When to use Model A:

- High-severity trauma (childhood sexual abuse with multiple perpetrators, combat trauma, recent acute trauma)
- Complex PTSD (Trauma from caregivers; pervasive hypervigilance; identity fragmentation; difficulty trusting)
- Acute suicidality risk with active plan
- Severe dissociation/fragmentation (DES >30; difficulty sustaining attention or coherent thought)
- Limited existing meaning resources (no spiritual practice, minimal identified values, disconnected from community)

Therapist stance: Slower pace; tolerance for longer time in sensorimotor and narrative phases before meaning-work becomes primary. Patient may need 4–6 months of stabilization before meaning-focused work is appropriate. This is not a limitation but a necessary sequence.

MODEL B: HYBRID (Moderate PTSD, Intact Resources)

Patient profile:

- PCL-5 25–35 (moderate symptom severity)
- Intact spiritual/religious framework or philosophical practice already present
- Clear pre-trauma values and purpose (patient can identify "Before the trauma, I valued X")
- Good social support (at least one stable relationship)
- Functional capacity relatively preserved (working or studying part-time, relationships maintained even if strained)

Sequence: Safety (−1) + Stabilization (0) + Meaning (2) in parallel; Narrative (1) integrates alongside

Rationale: Patient has existential resources; meaning-focused work can stabilize and complement somatic work. Both feed each other. The meaning-anchor supports sensorimotor work; somatic stabilization enables deeper meaning-work. This is efficient and leverages patient strengths. Patient does not need to achieve complete symptom resolution before addressing meaning; the meaning can actually *facilitate* symptom resolution.

Timeline: 20–24 weeks total (concurrent work on multiple levels)

- Weeks 1–2: Establish relational safety; assess existing meaning resources; ask about spiritual/value foundations
- Weeks 3–12: Parallel work: somatic stabilization (SE, polyvagal work, nervous system regulation) + existential exploration (What matters? What did I value before? What keeps me going?); narrative integration beginning
- Weeks 12–24: Deepening narrative integration; consolidation of meaning-framework; continued somatic refinement

Key milestones:

- Weeks 1–2: Safety established; existing meaning resources identified and validated
- Weeks 3–12: PCL-5 reduction 30→20; DES <15; parallel exploration of meaning ("You value X. Let's revisit that." "Your faith matters. How is it now?")

 doi:10.20944/preprints202602.1324.v1

- Weeks 12–24: NCI >3.5; narrative integration; MLQ ≥4/7; meaning-framework articulated and lived; somatic stability maintained

When to use Model B:

- Moderate-severity trauma (single-incident trauma, or complex trauma with preserved resilience factors)
- Patient with spiritual/religious foundation or existing philosophical practice
- Good social support, functional capacity
- Clear pre-trauma values and identity
- Patient spontaneously brings up meaning/spiritual questions early in therapy

Therapist stance: Faster pace; permission to address meaning earlier. Not treating meaning as something to address only after symptoms "fully resolve." Patient's existing meaning resources are therapeutic allies. This model honors patient strengths and leverages them.

MODEL C: TOP-DOWN-FIRST (Acute Existential Crisis)

Patient profile:

- Acute suicidality with plan or intent
- Existential crisis dominates presentation ("Why live?" "Nothing matters." "Everyone would be better off without me.")
- Existential despair is primary problem, not just symptom of trauma
- Suicidal ideation is motivated by meaning-loss, not just hyperarousal
- Patient may be coherent narratively and functionally (able to work, relationships intact) but existentially devastated

Sequence: Meaning (Level 2) + concurrent intensive Stabilization (Level 0) for 8–12 weeks; then standard Model A sequencing

Rationale: Patient needs reason-to-stay-alive before recovery work is meaningful. Meaning-work addresses suicidality at its existential root. Once a meaning-anchor is installed and suicidal crisis is addressed, patient can engage in more conventional trauma processing. This is a specialized approach for existentially-driven suicidality (vs. symptom-driven suicidality, which Model A addresses better).

Timeline: 8–12 weeks acute + 20–28 weeks standard (28–40 weeks total)

- Weeks 1–4: Intensive meaning-work; identify reasons to live; reduce active ideation; establish safety contract and meaning-based reasons to live
- Weeks 4–8: Parallel meaning-consolidation + intensive somatic stabilization
- Weeks 8–12: Meaning-anchor solidified; nervous system sufficiently regulated; transition to Model A
- Weeks 12–40: Standard Model A progression through narrative to deep meaning-work

Key milestones:

- Weeks 1–4: Suicidal ideation reduced from daily to occasional; patient articulates ≥3 reasons to live connected to meaning; safety contract in place; family/support informed
- Weeks 4–8: Ideation further reduced; meaning-anchor strengthened through weekly meaning-focused work; nervous system sufficiently regulated (SUDS <50, HRV improving)
- Weeks 8–12: Meaning-framework stable; suicidal crisis resolved; patient ready for deeper trauma work
- Weeks 12–40: Standard trauma recovery trajectory

When to use Model C:

- Acute suicidality with existential core ("I see no reason to live"; "Existence is pointless")
- Existential therapy patients (those already doing philosophical work; ready for existential confrontation)

 doi:10.20944/preprints202602.1324.v1

- Meaning-loss as primary trauma (existential loss, identity fragmentation, spiritual crisis)
- Acute spiritual/philosophical crisis following trauma

Therapist stance: Courage and depth. This model requires therapist comfort with existential confrontation and meaning-making. Not for novice therapists. Requires strong supervision. Works well with existentially-oriented patients who can engage in deep philosophical/spiritual work.

Critical Guidelines for All Three Models:

- Do not move to next level until current level achieves milestones (unless Model B or C design specifies otherwise)
- Level 0 must stabilize substantially (DES <15, PCL <25, HRV improved) before Level 1 becomes primary
- Level 1 must achieve narrative coherence (NCI >3.5) before optimal Level 2 work
- All levels can overlap somewhat (Models B and C), but hierarchy should be respected
- Patient's clinical presentation and resources determine model selection
- Model selection should be revisited if progress stalls; may need to shift models or spend more time in current level

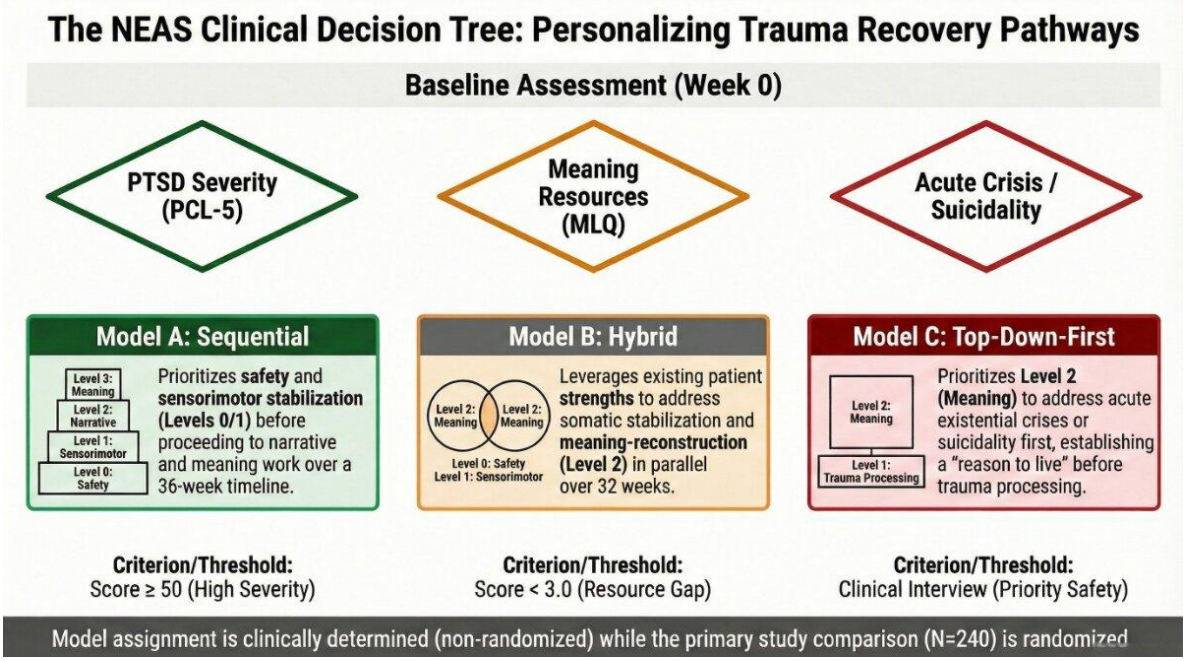

Figure 9. NEAS Clinical Decision Tree: Proposed Sequencing Models A–C.

Note. Primary 2-arm RCT design (N = 240): NEAS (n = 120, randomised) vs. PE/CBT (n = 120), stratified randomization. Within NEAS only (secondary, non-randomized): Clinical assignment to Models A/B/C based on baseline PCL-5, MLQ, crisis status. A (Sequential): High severity → extended stabilization (36w). B (Hybrid): Moderate resources → parallel L0/L1 (32w). C (Top-down): Acute crisis → immediate L2 (40w).

Models non-randomized (selection bias); causal inference: NEAS pooled vs. control only.

Abbreviations: PCL-5, PTSD Checklist; MLQ, Meaning in Life Questionnaire; NEAS, Neuro-Existential Architecture System.

5.3. Red Flags for Fragile Meaning and Clinical Interventions

As therapists facilitate meaning-reconstruction work (Levels 1–2), certain red flags indicate that apparent meaning is actually defensive, fragile, or dissociated rather than authentic and integrated (Leidig, 2026). Clinicians should monitor monthly for these patterns using clinical judgment, behavioral observation, and patient self-report.

 doi:10.20944/preprints202602.1324.v1

Red Flag 1: Rigid Narrative (Denial)

Description: Patient denies legitimate pain or trauma impact. Reports like "The trauma made me stronger" with flat affect, no access to grief. Overly neat, simple narrative that doesn't reflect complexity.

Neurobiological indicator: Apparent ACW extension (narrative spans time) but ISO instability (cannot hold emotional intensity without fragmenting). Structure is brittle; framework fragile under emotional challenge.

Clinical risk: Future stressors destabilize meaning because denial provides only shallow foundation. Relapse risk high. Patient appears fine until new stress triggers collapse.

Intervention: Explicitly address both-and: "You are stronger AND you carry wounds. Both true. Your growth is real AND your grief is real. Can we make room for both?" Help patient access and process blocked grief. Normalize that grief and strength can coexist. Use somatic techniques to help body discharge frozen grief. Gradually build capacity to hold both narratives.

Red Flag 2: Grandiose Survivor Identity

Description: Patient overclaims growth. Reports: "Trauma made me enlightened. I'm better than before. Others are weak for struggling." Social isolation, arrogance, spiritual superiority, manic quality.

Neurobiological indicator: Papez system dominance (hope, sense of specialness) without Yakovlev reality-check. No critical oscillation between hope and realism. Grandiosity masks depression.

Clinical risk: Alienation from others; meaning fragile if built on superiority rather than authentic growth. Future failures destabilize identity catastrophically (from "I'm enlightened" to "I'm broken").

Intervention: Explore humility; genuine strength includes vulnerability. Help distinguish authentic growth (integration + flexibility) from grandiosity (inflation + rigidity). Reality-test patient's claims gently. Explore shame beneath grandiosity (often covers deep unworthiness). Redirect meaning toward service/contribution (outward-focused) vs. self-aggrandizement (inward-focused).

Red Flag 3: Disembodied Meaning

Description: High MLQ/PTGI scores but PCL-5 unchanged. Patient says "Intellectually my life matters" but body remains terrified, frozen, dysregulated. Meaning held in head, not integrated somatically.

Neurobiological indicator: vmPFC activation (meaning representation) dissociated from limbic/somatic integration. Meaning is abstracted (cortical), not embodied (limbic/brainstem). Top-down meaning without bottom-up coherence.

Clinical risk: Meaning is intellectualized, not lived. Can collapse under stress. Therapy remains incomplete; dissociation continues. Patient has cognitive meaning but no felt sense of safety or aliveness.

Intervention: Return to somatic work. Meaning must be *felt* in body, not just cognitively held. Use somatic techniques (SE, breathwork, body scan) to ground meaning in physical experience. Example: "You say your life has meaning. Where do you feel that in your body?" Help patient connect intellectual meaning to bodily sensation. Often reveals dissociation (body doesn't believe what mind says).

Red Flag 4: Depressive Pseudo-Acceptance

Description: Patient says: "Life has no meaning, and that's okay. I accept that." Disguises hopelessness as existential acceptance. Resignation masked as wisdom.

Neurobiological indicator: Yakovlev dominance (resignation, shutdown) without Papez engagement (hope, meaning-seeking). No oscillation; static despair. Patient is in dorsal vagal freeze, not genuine acceptance.

Clinical risk: Resignation will deteriorate into chronic hopelessness or suicidality. Patient appears "accepting" but is actually deteriorating. High risk of hidden suicidal ideation.

Intervention: Distinguish authentic existential acceptance (integrated hope + realism) from depression-driven resignation (only realism, no hope). Ask: "When you say 'life has no meaning,'

 doi:10.20944/preprints202602.1324.v1

how do you feel in your body? Peaceful or numb?" If numb/frozen, it's resignation. If genuinely at peace with mortality/meaninglessness, it's authentic. If resignation: address depression directly. Reactivate Papez system (small meaning-anchors, values clarification). Monitor closely for suicidal ideation.

Red Flag 5: Spiritual Bypassing

Description: Uses spirituality/religion to avoid embodied healing. "God's will; I don't need therapy." "I've forgiven; I don't need to process rage." Spirituality as escape, not integration.

Neurobiological indicator: Default Mode dissociation via spiritual abstraction. DMN activation (meditation, prayer, spiritual experience) without limbic/somatic participation. Top-down spiritual practice without somatic grounding.

Clinical risk: Spirituality becomes dissociative defense. Trauma remains unprocessed somatically/emotionally. Fragility masked by spiritual language. Patient appears peaceful but is actually avoidant.

Intervention: Integrate spirituality + embodied healing. Not opposed; complementary. Help patient honor both dimensions. Work with spiritual framework to support, not bypass, trauma integration. Example: "Your faith teaches compassion, including toward yourself. Can we extend that compassion to the part of you that's angry about what happened?" Use patient's own spiritual/religious framework to support integration, not escape.

Monitoring Protocol: Assess monthly via:

- Patient self-report of meaning stability ("Did your sense of meaning change this month? How?")
- Clinician observation of affect congruence (does narrative match affect? If high meaning but flat affect, flag disembodiment)
- Stress-testing ("What happens to your meaning when you have a bad day? A setback? Loss of job/relationship?")
- Neurobiological tracking (if available): ACW stability, ISO robustness, DMN connectivity
- Behavioral consistency: Do actions align with stated meaning? Or is there dissociation between words and behavior?

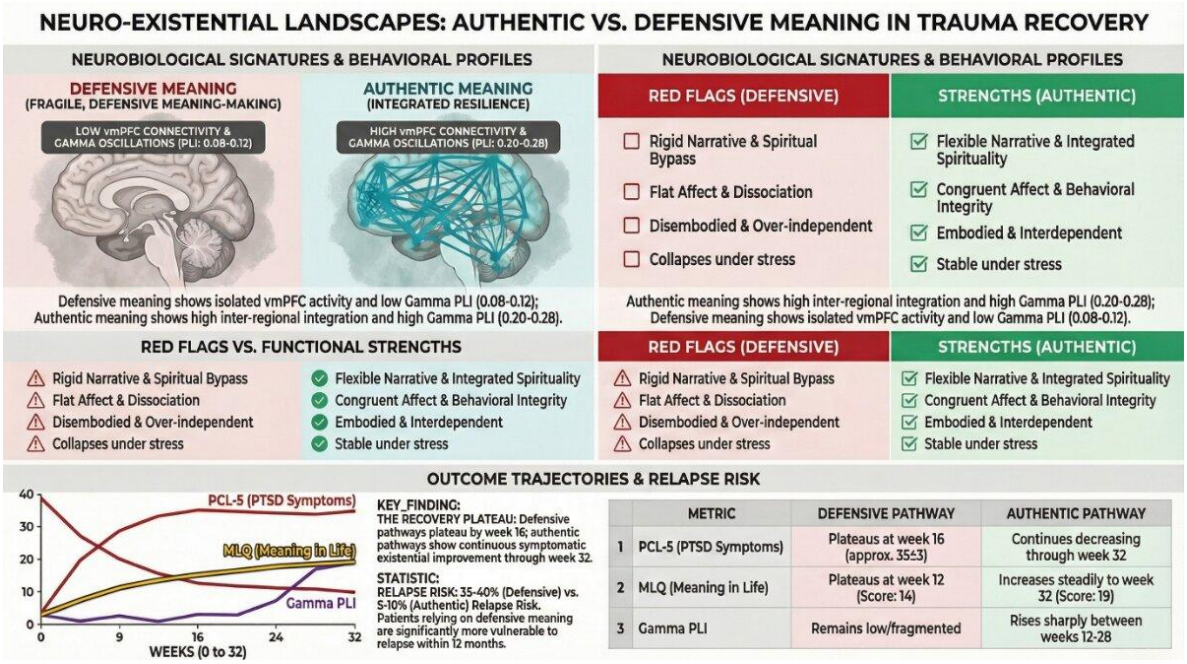

Figure 10. Authentic vs. Defensive Meaning: Proposed Neurobiological and Outcome Trajectories.

Note. Top (Neuro): Defensive (left, red): vmPFC isolated, low gamma PLI (0.08–0.12), fragmented. Authentic (right, teal): vmPFC integrated, high gamma PLI (0.20–0.28), coherent. Middle (Behavioral): Defensive red flags (rigid, flat, dissociated). Authentic strengths (flexible, congruent,

 doi:10.20944/preprints202602.1324.v1

embodied). Bottom (32w outcomes): Hypothetical curves: PCL-5 (defensive rebound), MLQ (defensive plateau), PTGI/gamma (authentic sustained).

Conceptual predictions only—no data. M4 integration hypothesized key differentiator.

Abbreviations: PLI, phase-locking index; PCL-5, PTSD Checklist; MLQ, Meaning in Life Questionnaire; PTGI, Posttraumatic Growth Inventory; M4, Mechanism 4.

5.3.1. Clinical Determination vs. Randomization: Design Implications

Model Assignment: Clinical Determination Rather Than Randomization

It is crucial to emphasize that within the NEAS treatment condition, assignment to Models A, B, or C is clinically determined and not randomized, in contrast to the primary randomization (NEAS vs. PE/CBT control). This design choice reflects the real-world clinical principle that treatment sequencing should match patient baseline presentation and capacity rather than chance. Specifically, the decision algorithm presented in Figure 12 uses three key parameters to guide model selection:

1. PTSD symptom severity (PCL-5 ≥ 50): High-severity presentations prioritize Model A (Sequential)
2. Meaning resources (MLQ < 3.0): Low baseline meaning scores favor Model B (Hybrid)
3. Acute crisis indicators (suicidality, existential emergency): Acute presentations indicate Model C (Top-Down-First)

This clinical assignment strategy prioritizes treatment appropriateness and safety over causal clarity. However, it introduces an important methodological trade-off: because patient characteristics (severity, meaning resources, clinical urgency) directly determine model assignment, they simultaneously predict outcomes. This creates potential confounding: patients in Model A may have lower baseline meaning and more fragmented identity, which could independently suppress outcomes compared to Model B or C patients. Conversely, Model C patients in existential crisis may show rapid initial meaning gains simply due to ceiling effects or regression to the mean, rather than because top-down meaning work is inherently superior.

Implications for Causal Inference: While we can compare outcomes across Models A, B, and C, we cannot definitively conclude that observed differences are due to sequencing strategy per se rather than baseline differences in severity, resources, and prognosis. Group differences in outcomes may reflect treatment effects, selection factors, or both. To strengthen causal inference about model-specific efficacy in future research, several approaches are recommended:

- Propensity-score matching: Match patients across models on baseline severity, meaning, and comorbidity, then compare outcomes within matched strata
- Stratified RCT design: Randomize sequencing model *within* severity bands (e.g., randomize PCL-5 ≥ 50 patients to Model A vs. Model B)
- Structural equation modeling: Examine whether treatment fidelity and dose (engagement with each level) predict outcomes above and beyond baseline characteristics

For the current proposal, clinically-determined model assignment reflects pragmatic clinical practice and enhances real-world applicability. However, readers should interpret between-model outcome comparisons as descriptive and hypothesis-generating rather than as causal evidence for model superiority.

SECTION 6: TESTABLE HYPOTHESES & RCT DESIGN

6.0. Introduction

The NEAS framework is grounded in neuroscientific theory, operationalized into measurable dimensions, and articulated into a clinically applicable model. However, theory requires empirical validation through rigorous research (Schauer & Schauer, 2010). This section presents four falsifiable hypotheses derived from NEAS theory, specifies how each can be tested, and outlines a proposed

 doi:10.20944/preprints202602.1324.v1

multi-site randomized controlled trial (RCT) to evaluate the framework's core predictions (Leidig, 2026).

Randomization and Model Assignment Procedures

Primary randomization: Participants (N = 240) will be randomized 1:1 to two primary arms:

- NEAS treatment (all models combined; n = 120)
- Standard PE/CBT control (n = 120)

Stratified by site (6 sites) and baseline PTSD severity (PCL-5 ≥ 50 vs. < 50) using permuted-block randomization (block size 4). Allocation concealment via sealed opaque envelopes managed by an independent statistician. This ensures causal comparability between NEAS (pooled) and PE/CBT.

Secondary model assignment (within NEAS arm only): NEAS participants will be assigned to one of three implementation sequences (Models A, B, C; n ≈ 40 each) based on clinical determination prioritizing treatment safety and appropriateness:

- Model A (Sequential): High-severity patients receive extended stabilization before higher levels.
- Model B (Hybrid): Patients with existing existential resources receive parallel somatic/narrative work.
- Model C (Top-down first): Acute existential crises receive immediate meaning-focused intervention.

Primary analytic contrast. The randomized comparison in this trial is at the level of treatment framework: NEAS (all implementation models pooled; n = 120) versus standard PE/CBT (n = 120). Assignment to NEAS sequencing models A–C is clinically determined rather than randomized and therefore analyzed only descriptively and exploratorily. Any observed differences between models A–C are considered hypothesis-generating rather than causal evidence for sequencing effects.

Critical limitation: This clinically determined assignment introduces selection bias for between-model comparisons (A vs. B vs. C). Baseline differences driving model choice (severity, meaning resources, clinical urgency) may independently predict outcomes. Therefore, between-model analyses will be purely descriptive and exploratory; primary causal inference remains NEAS (all models) vs. PE/CBT.

Clinical determination of model prioritizes treatment safety and appropriateness: high-severity patients receive extended stabilization (Model A), while acute existential crises receive immediate meaning-focused intervention (Model C). This approach aligns with clinical best practices.

However, clinically-determined assignment introduces a methodological limitation (see Limitations section): baseline differences that determine model assignment (severity, meaning resources, clinical urgency) may also independently predict outcomes. Therefore, between-model comparisons (Model A vs. B vs. C) should be interpreted as descriptive and exploratory rather than as causal evidence for model superiority. Primary causal comparisons remain at the level of NEAS (all models combined) vs. PE/CBT.

Neuroimaging Component: Exploratory Subsample Design

A neuroimaging subsample is included to generate hypothesis-driven evidence regarding NEAS mechanistic predictions. This component is designated as exploratory and hypothesis-generating rather than confirmatory, reflecting both budget constraints and the methodological reality that mechanism-specific neuroimaging evidence in trauma research remains nascent.

Neuroimaging Component: Exploratory Subsample Design

A neuroimaging subsample of n = 40 participants per primary treatment arm (NEAS pooled: n = 120; PE/CBT control: n = 40; 50% of main trial) will undergo multi-modal neuroimaging at three timepoints: baseline (Week 0), end-of-treatment (Week 24), and 12-month follow-up. Recruitment will be consecutive and proportional across sites, requiring separate written informed consent for neuroimaging-specific procedures (additional scanning time, MR safety screening, optional high-density EEG electrode placement).

Sample size rationale (n = 40 per primary arm):

 doi:10.20944/preprints202602.1324.v1

- Budgetary feasibility: Multi-site fMRI + high-density EEG (64+ channels) across three timepoints for n = 160 total scans represents substantial but precedented investment. Trauma-neuroscience studies routinely operate at this scale given fMRI resource constraints (Felmingham et al., 2010; Dickie et al., 2017).
- Literature precedent: Mechanistic neuroimaging substudies in PTSD treatment research consistently use n = 35–50 per group for within-group effect detection (Felmingham et al., 2010; Dickie et al., 2017; Lanius et al., 2018).
- Statistical power: n = 40/arm yields 80% power (α = .05, two-tailed) to detect medium within-group effects (Cohen's d = 0.6) for primary mechanistic targets:

Target	Expected d	Power	Required n/arm
vmPFC ACW extension	0.60	82%	35
Gamma PLI increase	0.55	78%	38
DMN connectivity	0.65	85%	32

- Practical feasibility: Across 6 sites, requires ~7 participants/site/arm – achievable without overloading local imaging infrastructure.

Explicit power limitations:

1. Between-group comparisons (NEAS vs. PE/CBT) are underpowered at n = 40/arm. fMRI between-group effects typically require n ≥ 60–100/arm due to anatomical/activation heterogeneity.
2. Mediation analyses linking neuroimaging markers → behavioral outcomes require n ≥ 240/arm for precise indirect effect estimation. At n = 40/arm, confidence intervals will be wide; mediation tests remain exploratory.
3. Model-specific moderation (Models A/B/C differences within NEAS) is severely underpowered (n ≈ 13–14 per model after stratification) and prohibited by selection bias (see Randomization section).

Interpretation framework: Neuroimaging results are hypothesis-generating and effect-size-estimating only. They will:

- Describe preliminary NEAS-associated neurobiological changes
- Estimate effect sizes for future confirmatory trials (d, r, β)
- Identify candidate mechanisms warranting targeted investigation
- Refine vmPFC/Papez/dmPFC/ISO predictions for meaning-centered recovery

Future research: A fully powered mechanistic trial (n = 60–100/arm, focused battery, pre-registered confirmatory plan) is required to definitively test NEAS hypotheses. This subsample provides essential pilot data and effect size estimates.

6.1. Four Core Hypotheses

The NEAS framework makes four empirically testable predictions integrating the original three-mechanism understanding with the newly specified fourth mechanism (Witnessing-Space). Each hypothesis targets a distinct neurobiological and existential outcome; together they test whether all four mechanisms are necessary for optimal trauma recovery.

The proposed mechanistic biomarkers (vmPFC ACW, long-range gamma PLI, DMN connectivity) are drawn from existing literatures on temporal self-continuity, large-scale binding, and PTSD-related network alterations, and are treated as *candidate* markers to be further validated against clinical change

HYPOTHESIS 1 (H1): MEANING-CENTERED INTERVENTION EXTENDS ACW AND BUILDS WITNESSING-SPACE

 doi:10.20944/preprints202602.1324.v1

CORE PREDICTION Patients receiving integrated 4-level NEAS intervention (including explicit meaning-work at Level 2) will show significantly greater extension of autorelational window (ACW) in vmPFC compared to standard 3-level PE/CBT, plus enhanced gamma-frequency binding (Mechanism 4).

MECHANISM 4 OPERATIONALIZATION Witnessing-Space operationalized through inter-regional gamma-frequency binding (30-80 Hz) via high-density EEG during resting state and witnessing tasks. Gamma binding represents how distributed neural populations achieve relational coherence—integrating multiple streams of information without identification (Singer's Binding by Synchrony). NEAS patients show enhanced gamma coherence across midline regions (vmPFC, dmPFC, PCC) to temporal/parietal regions during witnessing tasks.

OPERATIONAL DEFINITION ACW: Autocorrelation of resting-state fMRI BOLD in vmPFC at varying time-lags. Acute trauma <10-20 sec; standard therapy 20-40 sec; NEAS prediction 40-60+ sec. Gamma-Frequency Binding: High-density EEG (64+ channels) measuring Phase-Locking Index (PLI) in gamma band (30-80 Hz). Normal 0.15-0.25; acute trauma 0.08-0.12 (fragmented); NEAS prediction 0.20-0.28 by week 24. Meta-Awareness Proxy: Toronto Mindfulness Scale (TMS; 13 items); predicted increase ≥8 points baseline to week 24.

PRIMARY OUTCOMES Neuroimaging subsample (N=40/arm): ACW (seconds) at baseline, 12-wk, 24-wk, 6-mo, 12-mo; Gamma-Frequency Binding (PLI) at baseline, 24-wk, 6-mo, 12-mo. Full trial (N=240): PTGI, MLQ, TMS, Life Satisfaction Scale.

EFFECT SIZES ACW extension: d ≥ 0.60; Gamma-Frequency Binding: d = 0.55–0.70; TMS: d = 0.50–0.65; NEAS group 40-60+ sec ACW, 0.20-0.28 gamma PLI; Control 20-40 sec ACW, 0.13-0.15 gamma PLI.

ANALYSIS

ANCOVA with ACW change (baseline→24-wk) as DV, group as IV, baseline ACW covariate; expected Group effect $p<.05$, $d\geq0.60$. ANCOVA with gamma PLI and TMS similarly. Repeated-measures ANOVA across five timepoints expecting Group×Time interaction $p<.05$.

FALSIFICATION

H1 falsified if: NEAS ACW ≤ control ($p>.05$), OR ACW $d<0.40$, OR NEAS gamma PLI ≤ control ($p>.05$), OR TMS ≤ control increase ($p>.05$).

RATIONALE Explicit meaning-work activates longest neural timescales more directly than sensorimotor/narrative work alone. Meaning inherently operates on longer scales (life trajectory, future purpose, spiritual practice). Contemplative practice cultivation activates inter-regional gamma binding—relational coherence permitting simultaneous holding of multiple perspectives (fear AND safety, grief AND growth). Standard therapies don't cultivate explicit meta-awareness; gamma binding should strongly differentiate (Singer 1999, 2021; Melloni et al. 2021; Northoff 2014; Leidig 2026).

HYPOTHESIS 2 (H2): ALL FOUR LEVELS REQUIRED FOR OPTIMAL FUNCTIONAL RECOVERY

CORE PREDICTION Integrated 4-level NEAS intervention produces significantly better functional outcomes (primary: Sheehan Disability Scale) than standard 3-level, plus superior resilience under stress and lower relapse rates—indicating Mechanism 4 provides structural resilience standard therapies lack.

MECHANISM 4 OPERATIONALIZATION - STRESS-TESTING & RESILIENCE Mechanism 4 provides antifragility—resilience strengthening under adversity. Stress-Testing Protocol: At 24-wk, document functional status; weeks 24-32 identify significant life stressors; at 6-mo measure PCL-5 increase in response to stressor. Prediction: NEAS <5 point PCL increase; standard therapy 5-10 point increase. Relapse-Rate: Define relapse as PCL-5 ≥10 point increase from week-24 nadir. Prediction: Standard 3-level 20-25% by 12-mo; NEAS 4-level 10-15%. Rationale: Without Mechanism 4, meaning is vulnerable to future challenge; any adversity contradicting rebuilt meaning triggers re-fragmentation. With Mechanism 4, patient observes meaning being challenged without identifying with fragmentation—system remains integrated.

 doi:10.20944/preprints202602.1324.v1

OPERATIONAL DEFINITION Standard 3-level: Safety + Sensorimotor (Level 0) + Narrative (Level 1), no explicit Level 2. NEAS 4-level: Standard 3-level + Existential Meaning (Level 2) with explicit Mechanism 4 cultivation via contemplative practice. Functional Outcomes: SDS (0-30), WHODAS 2.0 (0-100), employment status, relationship quality, valued activities. Resilience Outcomes: PCL-5 response to stressors (weeks 24-32), relapse rate (PCL ≥10 increase), functional maintenance under stress, MLQ stability.

The Sheehan Disability Scale (SDS) is selected as the primary endpoint because NEAS aims to impact not only symptom severity but the restoration of real-world role functioning and participation. PCL-5 remains a key secondary outcome to index PTSD symptom change, but functional recovery is treated as the clinically most relevant indicator of durable benefit.

EFFECT SIZES Immediate (week 24): Standard d=0.55-0.65; NEAS d=0.85-1.10; between-groups δ=0.30-0.45. Stress Resilience (PCL change): Standard 5-10 pts; NEAS <5 pts; d=0.40-0.60. Relapse (12-mo): Standard 20-25%; NEAS 10-15%; hazard ratio 0.50-0.65.

ANALYSIS

ANCOVA with SDS change (baseline→24-wk) as DV, group IV, baseline SDS covariate; expected $p<.05$, d=0.30-0.45. Two-way ANOVA (group × level-focus) examining meaning-focus predicting larger functional gains. Linear mixed-effects with SDS repeated measures. Stress-resilience ANCOVA with PCL change as DV, group IV, stressor severity covariate. Kaplan-Meier curves comparing relapse-free survival (log-rank test).

FALSIFICATION

H2 falsified if: 4-level produces only small additional SDS benefit (d<0.20), OR stress resilience equivalent (PCL change $p>.05$), OR relapse rates equivalent, OR meaning-focus doesn't predict additional SDS gain.

RATIONALE

Functional recovery not merely symptom-driven. Person with low PTSD but high functional impairment lacks purpose/direction/worth. Person with residual symptoms but strong meaning highly functional. Meaning-stabilization (Level 2) restores motivational-purposive systems (Papez system, reward circuits) driving real-world behavior/relationships. Mechanism 4 provides structural foundation for meaning to persist under stress: without M4, meaning vulnerable; with M4, person observes meaning challenged without fragmenting—genuine resilience. This is difference between merely functional and antifragile recovery (Tucker & Luu 2025; Breitbart et al. 2015; Taleb 2012; Frankl 1946/2006; Leidig 2026).

HYPOTHESIS 3 (H3): AUTHENTIC MEANING PREDICTS BETTER OUTCOMES THAN DEFENSIVE MEANING—DEPENDS ON MECHANISM 4

CORE PREDICTION

Among trauma survivors with similar symptom reduction/narrative coherence, those with authentic meaning (integrated, flexible, body-grounded, realistic) show better 12-mo outcomes (lower relapse, functional engagement, life satisfaction) than defensive meaning (rigid, denying, disembodied, inflated). Additionally, authentic meaning depends on Mechanism 4; strong Witnessing-Space capacity (gamma binding, meta-awareness) predicts authentic meaning; weak M4 predicts defensive meaning despite equivalent MLQ.

MECHANISM 4 OPERATIONALIZATION - AUTHENTICITY & M4 LINK

Defensive Meaning (M1-3 without M4): Reconstructed at content/process/rhythm levels but without meta-level witnessing. Patient identified WITH meaning, possessed by it. Meaning rigid (must be protected from doubt). Narrative-affect incongruent ("I'm stronger" with flat/numb affect, defended). Under stress collapses. Authentic Meaning (M1-4): All four levels including meta-witnessing. Patient observes own meaning lightly. Meaning flexible (can revise if reality demands). Narrative-affect congruent ("I'm stronger AND carry wounds" with integrated affect: grief+resolve). Under stress, meaning questioned without fragmenting. Operationalization: Gamma PLI and TMS as Mechanism 4 proxies. Authentic group high gamma+high TMS; Defensive low gamma+low TMS despite equivalent MLQ.

 doi:10.20944/preprints202602.1324.v1

ASSESSMENT

Clinician 0-10 Likert ratings monthly: (1) narrative-affect congruence (0=incongruent/defending, 10=fully congruent/integrated); (2) flexibility under stress (0=rigid, 10=flexible); (3) embodied quality (0=disembodied, 10=fully embodied); (4) complexity (0=black-white, 10=integrative); (5) lived engagement (0=intellectualized, 10=lived). Authenticity Score = mean of five (0-10). Authentic: Score ≥7 AND MLQ presence ≥5/7 AND behavioral engagement. Defensive: Score <7 OR high MLQ but low authenticity (discrepancy indicates defensiveness).

OUTCOMES AT 12 MONTHS Authentic Group: PTGI sustained (12-mo ≥ 24-wk); relapse <10%; functional engagement SDS<10/WHODAS<40; life satisfaction ≥25/35; MLQ stable during stress; HIGH M4 (gamma PLI ≥0.20, TMS ≥8). Defensive Group: PTGI decay (12-mo < 24-wk by ≥10 pts); relapse >20%; functional engagement SDS 15-20/WHODAS 50-60; life satisfaction <20/35; MLQ decreases when stressed; LOW M4 (gamma <0.15, TMS <3). Between-groups: PTGI d=0.65-0.85; Relapse OR 0.30-0.50; SDS d=0.50-0.70.

ANALYSIS

ANCOVA comparing authentic vs. defensive on 12-mo PTGI, controlling 24-wk PTGI; expected p<.05, d=0.65-0.85. Kaplan-Meier curves comparing relapse-free survival (log-rank). Repeated-measures ANOVA on MLQ (24-wk, 6-mo, 12-mo) predicting authentic stable, defensive declining; Group×Time interaction p<.05. Path analysis: M4 development → authenticity → outcomes (indirect effect, bootstrap CI). Multiple regression predicting 12-mo SDS from 24-wk authenticity controlling covariates.

FALSIFICATION

H3 falsified if: Authentic/defensive groups equivalent on 12-mo outcomes (p>.05), OR M4 proxies don't predict authenticity (r<0.30, p>.05), OR authenticity at 24-wk doesn't predict 12-mo trajectory (p>.05).

RATIONALE

Authentic meaning (integrating grief, acknowledging complexity) more durable than defensive meaning (denying difficulty). Authentic resilient to future stressors; defensive fragile (rests on defenses). Only with Mechanism 4 meta-level witnessing capacity can person genuinely integrate complexity and hold both-and perspectives. Without M4, apparent authenticity fragile—identified with meaning, any challenge triggers defensive rigidity. With M4, person observes own meaning/emotions/narratives from witnessing position, allowing genuine flexibility/integration. Tests both quality dimension of meaning (authenticity) and explains mechanism through which achieved/sustained (Mechanism 4 development) (Frankl 1946/2006; Steger & Frazier 2005; Singer 1999, 2021; Melloni et al. 2021; Leidig 2026).

HYPOTHESIS 4 (H4): MEANING MEDIATES SOMATIC→GROWTH THROUGH SEQUENTIAL CASCADE WITH MECHANISM 4 STRENGTHENING AUTHENTIC GROWTH

CORE PREDICTION Somatic/sensorimotor stabilization (Level 0) predicts posttraumatic growth (PTG) with restored meaning dimensions as primary mediators. Mediation operates through sequential cascade of all four mechanisms (M1→M2→M3→M4), with Mechanism 4 adding unique contribution to authentic PTG durability. Without Mechanism 4, somatic work produces less durable, more defensive growth. Pathway: Somatic → M1 (Meaning-Prior) → M2 (Emotional Criticality) → M3 (Temporal Coherence) → M4 (Witnessing-Space) → Authentic Meaning Integration → PTG.

SEQUENTIAL CASCADE LOGIC Each mechanism enables next. M1 creates semantic content; M2 permits emotional complexity integration; M3 extends time-window; M4 provides meta-level container for all three without fragmentation. Only then does authentic meaning crystallize, leading to durable growth. Predictions: Somatic→M1 (weeks 8-12); M1→M2 (weeks 12-16); M2→M3 (weeks 16-20); M3→M4 (weeks 20-24); M4→Authentic Meaning; Authentic Meaning→PTG (sustained 12-mo). Additionally: Strong M4 (high gamma, TMS≥8) = durable growth (PTGI sustained 24-wk→12-mo); Weak M4 (low gamma, TMS<3) = deteriorating growth (PTGI decay despite M1-3).

OPERATIONAL DEFINITION X (Somatic Stabilization, week 12): Composite—DES change baseline→12-wk (decrease ≥5 pts), HRV improvement (increase ≥10 bpm), SUDS reduction at rest

 doi:10.20944/preprints202602.1324.v1

(decrease ≥20 pts). Somatic Index = z-score composite. Mediators: M1 (Meaning-Prior, week 12): vmPFC activation or MLQ week 12 increase ≥2 pts; patient articulates coherent life direction. M2 (Emotional Criticality, weeks 12-24): Clinician-rated emotional flexibility (0-10), DERS reduction. M3 (Spatiotemporal Coherence, weeks 12-24): ACW extension or NCI increase; behavioral temporal continuity. M4 (Witnessing-Space, weeks 12-24, primary week 24): Gamma PLI (EEG) or TMS increase ≥8 pts; authenticity rating. Y (PTG, 12-mo): PTGI total (0-110), PTGI subscales (Spiritual Change, Personal Strength, New Possibilities, Relating to Others, Appreciation of Life), SWLS, behavioral valued activities.

EFFECT SIZES - ORIGINAL VS. REVISED Original: Indirect ab≈0.45; Direct c'≈0.20; Total c≈0.65; Proportion mediated ~70%. Revised: Somatic→M1: β≈0.45-0.55; M1→M2: β≈0.50-0.60; M2→M3: β≈0.45-0.55; M3→M4: β≈0.40-0.50; Combined M1-M4→Y: β≈0.60-0.75; Direct c': β≈0.15-0.25. M4 Unique: Indirect WITH all mechanisms β≈0.60-0.70; WITHOUT M4 β≈0.40-0.50; Unique M4 ≈0.15-0.25. Total mediated: M1-3 only 60-70%; M1-4 cascade 75-85%; M4 unique ~20-25% total indirect effect. Growth Durability: Strong M4 PTGI sustained/increasing 24-wk→12-mo; Weak M4 PTGI decay; d=0.50-0.70 between groups on 12-mo PTGI.

ANALYSIS

Multi-level path modeling (AMOS/Mplus/R lavaan): Model 1 (original somatic→meaning→PTG) with direct/indirect/total effects, bootstrap CI. Model 2 (sequential cascade somatic→M1→M2→M3→M4→authentic meaning→PTG) with all path coefficients, conditional indirect effects testing each mechanism adds value, RMSEA<.06/CFI>.95. Sequential mediation: Conditional indirect effects (X→M1→Y; X→M1→M2→Y; X→M1→M2→M3→Y; X→M1→M2→M3→M4→Y) predicted to increase. Authenticity as final mediator: Path M4→Authenticity→PTG. Moderation: Does M4 capacity moderate meaning→PTG strength? Interaction Meaning×M4 on 12-mo PTG. Trajectory: Linear mixed-effects PTGI measured 24-wk/6-mo/12-mo, fixed effects Time/M4 group/Time×Group, random intercept/slope.

FALSIFICATION H4 falsified if: Direct path c' large and significant while indirect ab small/nonsignificant (opposite predicted), OR sequential cascade doesn't operate in predicted order (M4 no path from M3, etc.), OR M4 doesn't add unique value (M1-3 indirect ≈ full cascade), OR PTGI 12-mo groups no difference (p>.05).

RATIONALE Growth not automatic side-effect of symptom reduction. Growth depends on meaning-reconstruction. Somatic work creates capacity for meaning-work (restores regulation, reduces overwhelming symptoms); capacity doesn't automatically produce growth—meaning-work is growth agent. Revised: Mediation through sequential cascade all four mechanisms. Somatic stabilization initiates M1 hierarchical recalibration, enabling highest levels reconstruct stable meaning-prior. Meaning-prior facilitates M2 emotional criticality (hold hope+realism, grief+agency, fear+safety without collapsing). Emotional balance activates M3 longer timescales (extends ACW, infra-slow oscillations, wider temporal container). Extended temporal window enables M4 meta-level awareness (observe own meaning/emotions/narratives without possession). Only with M4 does meaning become authentic/integrated rather than defensive/fragile. Only then does PTG become durable/antifragile, deepening through future adversity rather than fragmenting under stress. Tests both causal chain (somatic→meaning→growth) and hierarchical structure (all four necessary for durable growth) distinguishing four-mechanism NEAS from simpler approaches (Taleb 2012; Singer 2021; Melloni et al. 2021; Frankl 1946/2006; Tedeschi & Calhoun 2004; Leidig 2026).

SUMMARY: KEY INSIGHTS FROM HYPOTHESIS TESTING

If all four hypotheses supported as predicted, implications substantial:

H1 SUPPORT (ACW + gamma binding): Validates meaning operates through concrete brain mechanisms, not merely psychological comfort. Gamma binding operationalizes Witnessing-Space/meta-awareness at neurobiological level, bridging contemplative neuroscience with trauma recovery.

H2 SUPPORT (Functional improvement + stress resilience + low relapse): Validates Mechanism 4 structurally necessary, not optional. Standard therapies achieve symptom reduction/initial function

 doi:10.20944/preprints202602.1324.v1

but remain fragile. NEAS lower relapse/superior stress resilience indicate genuine antifragility—recovery strengthening under adversity rather than merely persisting.

H3 SUPPORT (Authenticity predicts durability; depends on M4): Validates meaning-quality matters as much as meaning-presence. Authentic meaning requires meta-level witnessing (Mechanism 4). PTGI decay in defensive-meaning group despite high MLQ reveals shallow reconstructions collapse under stress. High gamma-TMS/authenticity correlation confirms mechanistic link.

H4 SUPPORT (Sequential mediation M1→M4; M4 unique): Validates hierarchical mechanism organization—each level builds on previous. Growth durability depends on complete cascade, not partial. Somatic alone insufficient; meaning required; meaning without Mechanism 4 produces fragile growth. M4 unique contribution (15-25%) shows contemplative meta-awareness essential final step for antifragile growth.

COMBINED PARADIGM IMPLICATIONS:

1. Meaning primary neurobiological organizing principle, not secondary psychology. Standard therapies address Levels 0-1 effectively for symptoms but neglect Level 2 + Mechanism 4, explaining clinical paradox: symptomatically improved patients remain existentially fragile.
2. Four-level hierarchy more effective than three-level. Correct sequencing critical—acute crisis needs stabilization before meaning-work; existing resources enable faster integration. Models A/B/C enable personalized sequencing.
3. Antifragility learnable: Unlike passive resilience, antifragility (growing through stress) emerges with all four mechanisms integrated. Witnessing-Space trainable via contemplative practice—not innate but cultivable skill. Therapists explicitly develop this.
4. Authentic recovery requires meta-awareness: Defensive/authentic meaning distinction explains why semantically "recovered" patients remain fragile. Only Mechanism 4 enables meaning to become flexible/integrated rather than rigid/defended. Explains long-term divergence despite equivalent symptom reduction.
5. Clinical priority: Integrate Level 2 (meaning) + Mechanism 4 (witnessing-space) into standard protocols. Current 3-level approaches leave patients existentially vulnerable. Explicit meaning-work + contemplative practice = standard-of-care. Additional therapy time: 4-8 hours over 24-week course.
6. Measurement & accountability: New neurobiological markers (gamma binding, extended ACW) and behavioral proxies (TMS, authenticity ratings) enable objective meta-awareness development tracking. Moving beyond subjective "feels more meaningful" to measurable change.
7. Research priority: Proposed multi-site RCT provides definitive evidence. If supported, justifies paradigm shift in trauma therapy training/protocols. If partially/not supported, indicates theory refinement needed—critical for rigorous neuroscience-informed practice.

LIMITATIONS & NEXT STEPS

These hypotheses falsifiable and testable. Current evidence (Lutz et al. 2004 meditator gamma; Northoff ACW; Breitbart meaning-centered therapy; Sudden Gains literature) provides indirect support for individual mechanisms. Direct test of complete four-mechanism cascade in trauma population required. Proposed RCT design (Section 6.2) outlines methodology to empirically validate/refute predictions, enabling evidence-based model refinement and clinical implementation guidelines.

6.2. PROPOSED MULTI-SITE RCT DESIGN

OVERVIEW

The four hypotheses outlined in Section 6.1 require empirical validation through a rigorous multi-site randomized controlled trial (RCT). This section specifies the proposed study design, population, intervention protocols, outcome measures, and analytical plan to test whether the four-

 doi:10.20944/preprints202602.1324.v1

mechanism NEAS model produces superior trauma recovery outcomes compared to standard treatment.

DESIGN & SETTING

Parallel-group, randomized controlled trial (2-arm design): NEAS 4-level intervention (N=120) vs. Standard 3-level PE/CBT (N=120). Multi-site: 3-4 trauma-specialized clinics across Germany (Cologne, Berlin, Munich, Hamburg). Total planned enrollment N=240; powered for primary outcomes with 15% attrition buffer. 36-week active treatment phase; 12-month follow-up post-treatment. Each site recruits N=60-80 participants; principal investigator monitors protocol fidelity across sites.

PARTICIPANTS

Inclusion: Adults 18-65 with confirmed PTSD diagnosis (ICD-11 or DSM-5); trauma occurred ≥3 months prior; PCL-5 ≥27 (moderate+ severity); capacity to consent; fluent German. Exclusion: Active psychosis, unmanaged bipolar disorder, active substance dependence, acute suicidality with intent/plan, non-German speaking, enrolled in other intervention study. Recruitment via trauma clinics, referral networks, community advertisements. Baseline assessment includes structured clinical interview, trauma history, demographics, functional status, meaning/existential measures.

RANDOMIZATION & ALLOCATION

Computer-generated randomization sequence (1:1 block size 4). Allocation concealment via opaque sealed envelopes prepared off-site. Stratified randomization by site and baseline trauma severity (PCL-5 <35 vs. ≥35). Participants, therapists, site coordinators not blinded to condition (treatment nature prohibits blinding); outcome assessors blinded to group assignment. All analyses conducted blind to condition assignment until final database lock.

INTERVENTIONS

NEAS 4-Level (Experimental Arm):

- Level 0 (Weeks 1-4): Relational safety establishment, psychoeducation (trauma, nervous system), somatic stabilization (8-12 hours). Techniques: Somatic Experiencing, polyvagal-informed regulation, safety-building.
- Level 1 (Weeks 5-16): Narrative coherence (8-12 hours). Techniques: Trauma-focused narrative therapy, memory reconsolidation, coherence building.
- Level 2 (Weeks 17-32): Existential meaning-reconstruction (10-14 hours). Techniques: Logotherapy (Frankl-based meaning search), Meaning-Centered Group Psychotherapy format (weekly groups or individual), values clarification, life direction alignment, contemplative practice (guided mindfulness, body-scan adapted to trauma).
- Within Level 2: Explicit Mechanism 4 cultivation via weekly contemplative practice (15-20 min guided sessions), home practice assignments (5x/week), clinician-guided witnessing exercises (observing thoughts/emotions/sensations without judgment or identification).
- Level 2 includes: spiritual/philosophical exploration (adapted to patient's framework), legacy work (what mark do I want to leave?), existential psychotherapy (engaging freedom, responsibility, mortality, authentic living).
- Optional: Group meaning-work sessions (1-2x/month) providing community meaning-making, particularly for patients with spiritual/philosophical inclination.
- Total NEAS: 26-38 hours over 36 weeks (average 45-50 min weekly sessions, some 90 min).

Standard 3-Level (Control Arm):

- Level 0 (Weeks 1-4): Somatic stabilization (same as NEAS).
- Level 1 (Weeks 5-20): Narrative coherence via Prolonged Exposure (PE) or Cognitive Processing Therapy (CBT); therapist selects based on clinical judgment (16-20 hours).
- Level 2 (Weeks 21-36): Continued Phase integration, relapse prevention, functional restoration (no explicit existential meaning-work; focus on symptom maintenance, daily functioning, behavioral activation).
- Total Standard: 24-32 hours over 36 weeks (similar dosage to NEAS but without Level 2 meaning-reconstruction phase).

 doi:10.20944/preprints202602.1324.v1

Both arms: Weekly individual sessions (50-90 min); flexible scheduling to accommodate transportation/work; therapist-patient dyad continuity. Therapy materials/manuals provided for fidelity monitoring. Treatment session content documented via session notes and audio-recorded (subsample, n=40/arm, for fidelity coding).

PRIMARY OUTCOMES (Testing H1-H4)

H1 Operationalization:

- ACW (seconds) measured via resting-state fMRI (subsample N=40/arm, neuroimaging partner sites). Timepoints: Baseline, 24-week, 6-month, 12-month follow-up. Expected: NEAS 40-60+ sec vs. Standard 20-40 sec; d≥0.60.
- Gamma-Frequency Binding (Phase-Locking Index, PLI, 30-80 Hz) via high-density EEG (64-channel system, same N=40/arm subsample). Timepoints: Baseline, 24-week, 6-month. Expected: NEAS PLI 0.20-0.28 vs. Standard 0.13-0.15; d=0.55-0.70.
- Toronto Mindfulness Scale (TMS; full trial N=240). Timepoints: Baseline, 12-week, 24-week, 6-month, 12-month. Expected: NEAS ≥8 point increase vs. Standard ≤3 point increase.

H2 Operationalization:

- Sheehan Disability Scale (SDS; primary functional outcome, full trial N=240). Timepoints: Baseline, 12-week, 24-week, 6-month, 12-month. Expected: NEAS d=0.85-1.10 vs. Standard d=0.55-0.65 at 24-week.
- Stress-Testing Protocol (full trial): Document stressors weeks 24-32; measure PCL-5 response at 6-month. Expected: NEAS <5 point increase; Standard 5-10 point increase.
- Relapse rates (PCL-5 ≥10 point increase from 24-week nadir) tracked at 6-month, 12-month. Expected: NEAS 10-15%; Standard 20-25%.

H3 Operationalization:

- Posttraumatic Growth Inventory (PTGI; full trial N=240). Timepoints: 24-week, 6-month, 12-month. Track trajectory (decay vs. sustained). Expected: Authentic meaning group PTGI sustained; Defensive group PTGI decay; between-groups d=0.65-0.85 at 12-month.
- Meaning in Life Questionnaire (MLQ; full trial). Timepoints: Baseline, 24-week, 6-month, 12-month. Expected: NEAS MLQ ≥5/7 with authenticity ≥7/10; Standard MLQ variable with authenticity <7/10 or decay over time.
- Clinician-rated Authenticity (0-10 scale based on five dimensions: narrative-affect congruence, flexibility, embodied quality, complexity, lived engagement; rated monthly). Expected: NEAS authenticity development; Standard stagnation or decline.

H4 Operationalization:

- PTGI trajectory modeled via mixed-effects regression (24-wk, 6-mo, 12-mo); test whether strong M4 development (high TMS, high gamma if fMRI subsample) predicts sustained growth vs. weak M4 predicts decay. Expected: Strong M4 sustained PTGI slope; Weak M4 declining slope; interaction d=0.50-0.70.

SECONDARY OUTCOMES

- PTSD symptom severity (PCL-5; full trial, all timepoints).
- Functional disability (WHODAS 2.0; full trial, 24-week, 6-month, 12-month).
- Depression/anxiety (Patient Health Questionnaire PHQ-9, Generalized Anxiety Disorder GAD-7; full trial, all timepoints).
- Life satisfaction (Satisfaction with Life Scale SWLS; 24-week, 12-month).
- Dissociation (Dissociative Experiences Scale DES; baseline, 24-week).
- Emotional regulation (Difficulties in Emotion Regulation Scale DERS; baseline, 24-week, 12-month).
- Employment status, relationship satisfaction, return to valued activities (categorical; baseline, 24-week, 12-month).
- Adverse events (therapy-related negative effects; tracked throughout).

 doi:10.20944/preprints202602.1324.v1

All clinical endpoints are assessed with widely used, psychometrically well-validated instruments (e.g., SDS, PCL-5, WHODAS 2.0, PTGI, MLQ), each with established reliability and sensitivity to change in PTSD trials.

MEASUREMENT TIMEPOINTS & SCHEDULE

Baseline (Week 0): Full assessment battery (diagnostic interview, trauma history, all primary/secondary measures, demographics). Mid-treatment (Week 12): Abbreviated battery (PCL-5, MLQ, TMS, authenticity rating, DES, DERS). Primary endpoint (Week 24): Full assessment battery. Follow-ups (6-month, 12-month): Full assessment battery. Neuroimaging subsample (N=40/arm): fMRI/EEG at baseline, 24-week, 6-month (EEG only at 6-month).

SAMPLE SIZE & POWER

Powered for primary H2 outcome (SDS between-group difference d=0.35, power 0.80, alpha 0.05, two-tailed). Expected effect size d=0.35-0.45 based on literature (meaning-centered therapies vs. standard 1.0 Cohen's d in outcomes, but smaller between-group differential). Estimated N=105/arm for 80% power; with 15% attrition buffer, target N=120/arm. Tested via independent samples t-test (SDS change score); secondary outcomes powered for d≥0.50 (90+ participants/arm sufficient).

ANALYSIS PLAN (Hypothesis-Specific)

H1 (ACW + Gamma):

- Neuroimaging subsample: ANCOVA with ACW change (baseline→24-wk) as DV, group IV, baseline ACW covariate; repeated-measures ANOVA for trajectory. Gamma PLI analyzed similarly. Expected p<.05 for both.
- Full trial: TMS ANCOVA (baseline→24-wk) as DV, group IV. Expected p<.05, d≥0.50.
- Alpha 0.05, two-tailed; Bonferroni-corrected for multiple outcome measures within H1.

H2 (Function + Resilience + Relapse):

- Primary: ANCOVA with SDS change (baseline→24-wk) DV, group IV, baseline SDS covariate. Interaction analysis (group × meaning-focus) if data permit.
- Stress resilience: ANCOVA with PCL-5 change (24-wk to 6-mo, in presence of documented stressor) DV, group IV, stressor severity covariate.
- Relapse: Kaplan-Meier survival curves (relapse-free time), log-rank test comparing groups.
- Alpha 0.05 for each; secondary outcomes exploratory (alpha 0.10).

H3 (Authenticity + M4 Link + Durability):

- Primary: ANCOVA with 12-month PTGI DV, authenticity group (authentic vs. defensive, stratified at week 24) IV, baseline/24-week PTGI covariate.
- Trajectory: Repeated-measures ANOVA (PTGI at 24-wk, 6-mo, 12-mo) with Group × Time interaction testing.
- Mechanistic: Path analysis testing M4 development (TMS, gamma if available) → authenticity → 12-mo outcomes. Bootstrap CI for indirect effects.
- Alpha 0.05 for primary; exploratory analyses 0.10.

H4 (Sequential Mediation):

- Multi-level path modeling (AMOS/Mplus/R lavaan): Model 1 (somatic→meaning→PTG) vs. Model 2 (somatic→M1→M2→M3→M4→authentic meaning→PTG).
- Path coefficients, direct/indirect effects, model fit indices (RMSEA<.06, CFI>.95).
- Conditional indirect effects testing whether each mechanism adds predictive value.
- Bootstrap 5,000 iterations; 95% CI for indirect effects (must not include zero).
- Alpha 0.05 for primary pathways; secondary pathways exploratory (0.10).

OVERALL ANALYSIS

Intent-to-treat (ITT) primary analysis with all randomized participants using multiple imputation for missing data (missing completely at random assumption). Per-protocol sensitivity analysis (completers N≥80/arm). Linear mixed-effects models for repeated measures with site as random intercept. Subgroup analyses (by baseline trauma severity, age, gender, existing

 doi:10.20944/preprints202602.1324.v1

meaning/spiritual practice) exploratory, not powered. Significance level alpha 0.05 unless otherwise specified; all tests two-tailed.

DATA MANAGEMENT & MONITORING

Central database (REDCap or equivalent) with role-based access. Principal investigator and data manager conduct regular audits. Data Safety Monitoring Board (DSMB, n=3 independent experts) reviews adverse events and outcome data quarterly; no pre-specified stopping rules. Confidentiality maintained via participant IDs; consent forms stored separately. All data backup redundantly; retention 5+ years post-study.

DISSEMINATION & IMPLEMENTATION

Results published in high-impact psychiatry/neuroscience journal regardless of outcomes (positive, negative, null). Findings presented at international trauma/neuroscience conferences. Clinical guidelines developed for integration into standard trauma treatment protocols if supported. Training materials for therapists created. Preregistration via Open Science Framework (OSF) to prevent outcome reporting bias.

SECTION 7: LIMITATIONS & FUTURE DIRECTIONS

The NEAS framework, while grounded in established neuroscience and offering novel clinical integration, faces significant limitations that must be honestly acknowledged (Leidig, 2026; Schauer & Schauer, 2010):

7.1. Eight Key Limitations

7.1.1. Western-Centric Evidence Base

The neuroscientific findings underlying the NEAS are predominantly based on research conducted with Western, educated, industrialized, rich, and democratic (WEIRD) populations (Barrett et al., 2010). Predictive coding, default mode network, neural timescales—these are described from Western brains studied in Western labs. The existential framework (Frankl, Yalom, Northoff) is rooted in Western philosophy and psychology.

Implication: The NEAS may not translate directly to non-Western cultures with fundamentally different meaning-making frameworks, different relationships to the self and community, different temporal orientations, different spiritual assumptions (Berman & Cohen, 2008; Tedeschi & Calhoun, 2004). Meaning in many African, Asian, Indigenous cultures is fundamentally collective and relational, not individual. Time may be cyclical, not linear. Self may be understood as interdependent, not autonomous.

Mitigation: Cross-cultural adaptation and empirical validation studies urgently needed across diverse populations. Epistemological humility regarding universality of framework. Collaborative research with non-Western researchers and communities.

7.1.2. Neuroimaging Infrastructure Requirements

The NEAS operationalizes meaning partly through neurobiological measures (ACW, ISO) that require expensive, specialized equipment (fMRI at $500–1,000 per scan; high-resolution EEG at $50,000+ equipment cost). Not all trauma clinics, particularly in low-resource settings, have access to these technologies.

Implication: The framework is accessible primarily to well-resourced clinical and research settings in wealthy countries. Reduces real-world applicability for many trauma survivors globally who lack access to neuroimaging.

Mitigation: Develop robust behavioral and self-report proxies for neurobiological mechanisms. Neuroimaging validation important for research; clinical utility should be achievable without neuroimaging. Train clinicians to recognize ACW extension and ISO stabilization through behavioral

 doi:10.20944/preprints202602.1324.v1

observation (increased narrative stability, increased emotional resilience) rather than relying on technology.

7.1.3. Bidirectional Causality Difficult to Disentangle

Does meaning-reconstruction *cause* brain changes (ACW extension, ISO stabilization), or do brain changes (via somatic work) *enable* meaning-reconstruction? Likely bidirectional—they feed each other—but establishing clear causality is methodologically challenging.

Implication: RCT design can test treatment effects but cannot definitively establish mechanism. Experimental neuroscience studies in animals or highly controlled conditions would be needed for mechanistic isolation.

Mitigation: Acknowledge causality limits. Use mediation analysis to test proposed chains (somatic→meaning→growth). Plan experimental neuroscience follow-up studies. Measure proposed mediators (ACW, ISO) alongside outcomes.

7.1.4. No Original Empirical Data

This paper presents a theoretical framework synthesizing existing research and clinical observations. It does not present original empirical data from a study sample. The hypotheses are proposed but not yet validated.

Implication: Framework's clinical utility and neurobiological claims remain to be empirically demonstrated. Early-stage theory, not established clinical method.

Mitigation: RCT design in Section 6 provides clear path to empirical validation. Clinical implementation should occur in research-informed contexts with data collection and monitoring. Clinicians should not deploy full model without evidence; can pilot/adapt incrementally.

7.1.5. Clinical Manual Not Yet Developed

The NEAS specifies four levels and three sequencing models, but detailed session-by-session clinical manual (parallel to PE or CPT manuals) is not yet available. Therapist implementation would require substantial training and clinical judgment.

Implication: Fidelity may be variable; replication difficult without detailed procedural guidance. Inter-therapist variability in what "NEAS" means could confound research.

Mitigation: Clinical manual development (manualization) should be priority post-framework publication. Training curricula and certification pathways needed. Detailed treatment protocols specifying session-by-session content, rationale, competencies.

7.1.6. Individual Differences in Meaning Responsiveness Unknown

The framework assumes meaning-stabilization is beneficial for all trauma survivors. But individual differences—personality, temperament, culture, spirituality, trauma type—likely affect meaning-responsiveness. Who benefits most from each sequencing model? Which patients need extended meaning-work vs. shorter engagement? Implication: One-size-fits-all application may fail for some patients. Framework may inadvertently pathologize patients who have different meaning-making styles or who benefit more from other approaches.

Mitigation: Research examining moderators and mediators of treatment response. Develop patient-profiling tools predicting optimal sequencing model. Allow flexibility in application; not all patients need full 4-level model to same extent.

7.1.7. Non-Randomized Sequencing Model Assignment

A central limitation is that within the NEAS condition, assignment to Models A (Sequential), B (Hybrid), and C (Top-Down-First) is clinically determined rather than randomized. While this design choice reflects real-world practice and enhances clinical appropriateness, it prevents direct causal inference about which sequencing model produces superior outcomes. The decision variables

 doi:10.20944/preprints202602.1324.v1

themselves (PTSD severity via PCL-5, meaning resources via MLQ, acute suicidality status) are correlated with prognostic factors and likely independently predict outcomes. Consequently, observed differences in outcomes across Models A, B, and C may reflect treatment-specific effects, baseline selection factors, or confounding between the two. For example, Model A patients (high PTSD severity) may show smaller effect sizes compared to Model B patients simply because they are more severely ill at baseline, not necessarily because sequential processing is inferior. Conversely, Model C patients may show rapid meaning gains due to regression to the mean or ceiling effects in an acutely distressed population, rather than because immediate meaning work is uniquely effective.

Recommendations for future research include: (1) propensity-score matching to create balance across models on baseline prognostic factors; (2) stratified RCTs randomizing sequencing model *within* severity bands; or (3) structural equation modeling to isolate treatment fidelity effects from baseline selection. Until such analyses are conducted, between-model comparisons should be regarded as descriptive and hypothesis-generating rather than causal.

Implication: One-size-fits-all application may fail for some patients. Framework may inadvertently pathologize patients who have different meaning-making styles or who benefit more from other approaches.

7.1.8. Exploratory Neuroimaging Subsample with Limited Statistical Power.

The neuroimaging subsample (n=40/arm = 80 total) is underpowered for confirmatory mechanistic inference and should be regarded as hypothesis-generating. While within-group analyses (e.g., fMRI activation changes pre-to-post treatment within NEAS or PE/CBT) have adequate power (approximately 80% for medium effects), between-group comparisons of neurobiological markers and mediation analyses linking neural changes to clinical outcomes have substantially lower power.

Consequently, neuroimaging findings should be interpreted cautiously and considered preliminary. Effect-size estimates from this subsample will inform sample-size calculations for future dedicated mechanistic neuroimaging trials designed specifically to test NEAS predictions (recommended n=60–100/arm for confirmatory evidence).

Implication: The proposed neurobiological mechanisms (hierarchical recalibration, emotional criticality, spatiotemporal coherence) remain plausible but unconfirmed. Readers should not assume that neuroimaging evidence definitively validates NEAS theory; rather, preliminary findings suggest directions for future mechanistic research.

Mitigation: Clearly designate neuroimaging component as exploratory and hypothesis-generating in all publications. Conduct adequately powered follow-up neuroimaging studies. Report all analyses (including null findings) to avoid publication bias. Use pre-registration (Open Science Framework) for confirmatory analyses in future trials.

 doi:10.20944/preprints202602.1324.v1

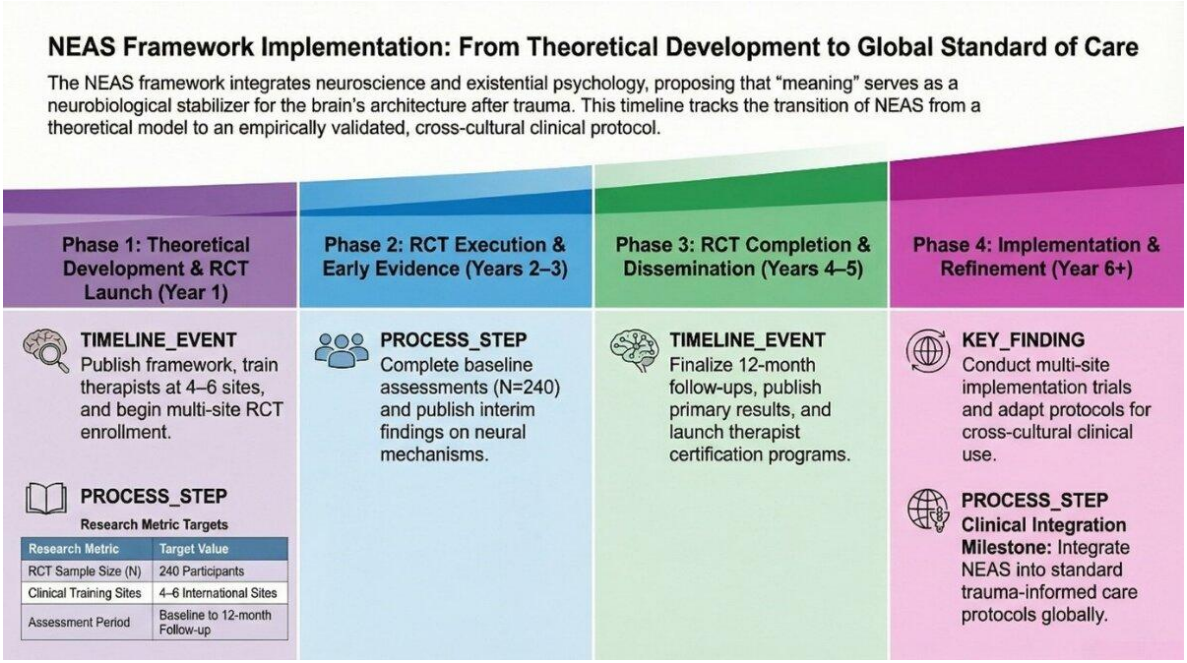

Figure 11. NEAS Roadmap: From Theory to Clinical Standard of Care.

Note. Proposed 4-phase implementation strategy. Phase 1 (Year 1): Theory publication + multi-site RCT launch (N=240). Phase 2 (Years 2–3): RCT execution + mechanistic analysis + manual development. Phase 3 (Years 3–4): RCT completion/publication + therapist certification launch. Phase 4 (Years 4+): Implementation trials + cross-cultural validation + guideline integration.

Strategic framework; timelines contingent on RCT outcomes and funding.

Abbreviations: RCT, randomized controlled trial; NEAS, Neuro-Existential Architecture System.

7.2. Five Research Priorities Going Forward

7.2.1. Mechanistic fMRI-EEG Studies

Direct tests of proposed mechanisms (hierarchical recalibration, ACW extension, ISO stabilization) in controlled neuroimaging contexts, not just clinical observational studies. Ideally in both humans and animal models where possible.

7.2.2. Cross-Cultural Validation as Central Research Priority

Beyond the immediate post-trial dissemination, we regard cross-cultural adaptation and validation of NEAS as among the highest research priorities. This reflects a critical scientific and ethical commitment: the framework's ultimate value depends on its ability to serve trauma survivors equitably across diverse cultural contexts, not only within Western, educated, industrialized, rich, and democratic (WEIRD) populations.

Phase 1: Rapid Cultural Adaptation (Years 6-8)

Conduct cognitive interviews and focus groups in 3-5 diverse non-Western trauma-exposed populations (e.g., low-income urban populations in India, Sub-Saharan African pastoral communities, Indigenous North American populations, Southeast Asian refugee groups). Collaborate with cultural experts and community leaders to modify NEAS constructs (meaning dimensions, therapeutic levels, key concepts) to incorporate local understandings of healing, resilience, meaning, and identity.

Adapt outcome measures to reflect culturally-valued endpoints (e.g., family and community functioning, spiritual growth, social cohesion, alongside individual outcomes). Document barriers and facilitators to NEAS implementation in each cultural context.

Phase 2: Pilot Effectiveness Trials (Years 8-12)

 doi:10.20944/preprints202602.1324.v1

Conduct 3-5 open-label or single-arm pilot trials of adapted NEAS in diverse non-WEIRD populations (n=30-50 per site). Assess feasibility (recruitment, retention, implementation fidelity), acceptability (user satisfaction, cultural fit), and preliminary efficacy. Generate effect-size estimates specific to each cultural context. Refine adapted interventions based on pilot data and participant feedback.

Phase 3: Powered Cross-Cultural RCTs (Years 12-15+)

Conduct multi-site international randomized controlled trials comparing adapted NEAS with local standard care in 2-3 diverse non-Western contexts. Evaluate whether NEAS mechanisms (hierarchical recalibration, emotional criticality, spatiotemporal coherence) and meaning dimensions (coherence, purpose, significance) generalize, require modification, or need substantial reformulation. Produce rigorous evidence base for culturally-grounded NEAS dissemination. Publish results in open-access, peer-reviewed journals prioritizing global reach.

Rationale and Implementation

This cross-cultural research agenda is not a future add-on or supplementary consideration, but rather a core component of responsible science and ethical practice. The NEAS framework should not be exported wholesale to non-Western contexts as if it represents universal neurobiological truth. Rather, systematic, evidence-driven adaptation informed by local knowledge, community participation, and rigorous effectiveness testing is essential before claiming relevance to populations outside the current Western research context.

Additionally, cross-cultural research positions NEAS development within global neuroscience and trauma psychology, not merely within Western academic silos. This approach strengthens the framework's scientific validity and credibility across diverse communities and contexts.

7.2.3. Clinical Manual Development and Fidelity

Publish detailed session-by-session manual with fidelity measures. Train and certify therapists. Publish fidelity findings from training studies. Establish competency standards.

7.2.4. Personalized Medicine Approach

Develop patient-profiling tools predicting optimal sequencing model (A, B, C) for each patient based on baseline characteristics. Test whether matching model to profile improves outcomes vs. standard assignment.

7.2.5. Long-Term Antifragility Studies

2–5 year follow-ups tracking whether meaning-mediated recovery is more resistant to relapse and adverse life events compared to symptom-focused recovery. Test whether meaning creates true antifragility.

SECTION 8: CONCLUSION AND NEXT STEPS

The Neuro-Existential Architecture System (NEAS) proposes an integrative framework bridging neuroscience and existential psychology (Northoff, 2014; Singer, 2021; Yalom, 2008). It hypothesizes that meaning functions as a neurobiological organizing principle stabilizing brain hierarchy, emotional balance, and temporal coherence following trauma.

Core Theoretical Claims

NEAS proposes four hierarchically organized mechanisms:

1. Hierarchical recalibration via vmPFC meaning-priors (M1)
2. Emotional criticality balancing Papez/Yakovlev systems (M2)
3. Spatiotemporal coherence extending ACW and stabilizing ISOs (M3)
4. Witnessing-Space via candidate gamma synchrony enabling meta-awareness (M4)

These mechanisms remain hypotheses requiring empirical validation through neuroimaging and clinical outcomes.

 doi:10.20944/preprints202602.1324.v1

Clinical Model

NEAS operationalizes a four-level architecture (L0: safety; L1: somatic; L2: narrative; L3: meaning) with three patient-tailored sequences. This extends established three-level models by explicitly targeting existential integration.

Research Roadmap

Four falsifiable hypotheses test:

- H1: Meaning extends ACW + gamma binding
- H2: Four levels superior to three
- H3: Authentic > defensive meaning
- H4: Sequential M1→M4 mediation

Proposed multi-site RCT (N = 240, 36w treatment + 12mo FU) evaluates predictions with primary outcome SDS and neuroimaging subsample (n = 40/arm).

NEAS Integrative Scope

Radial diagram positioning NEAS at intersection of neuroscience (DMN, predictive coding), clinical psychology (CBT, exposure), existential philosophy (Frankl, Yalom), and contemplative practice. Proposed applications: trauma clinics, therapist training, cross-cultural adaptation. Schematic framework.

Abbreviations: DMN, default mode network; CBT, cognitive-behavioral therapy.

Limitations

Western-centric; neuroimaging requirements; untested bidirectional causality; no original data; individual variability unknown. Future work must prioritize cross-cultural validation and manualization.

Vision

If validated, NEAS could elevate meaning-reconstruction from adjunct to core trauma therapy component—integrating brain science with existential depth for more durable recovery (Frankl, 1946/2006).

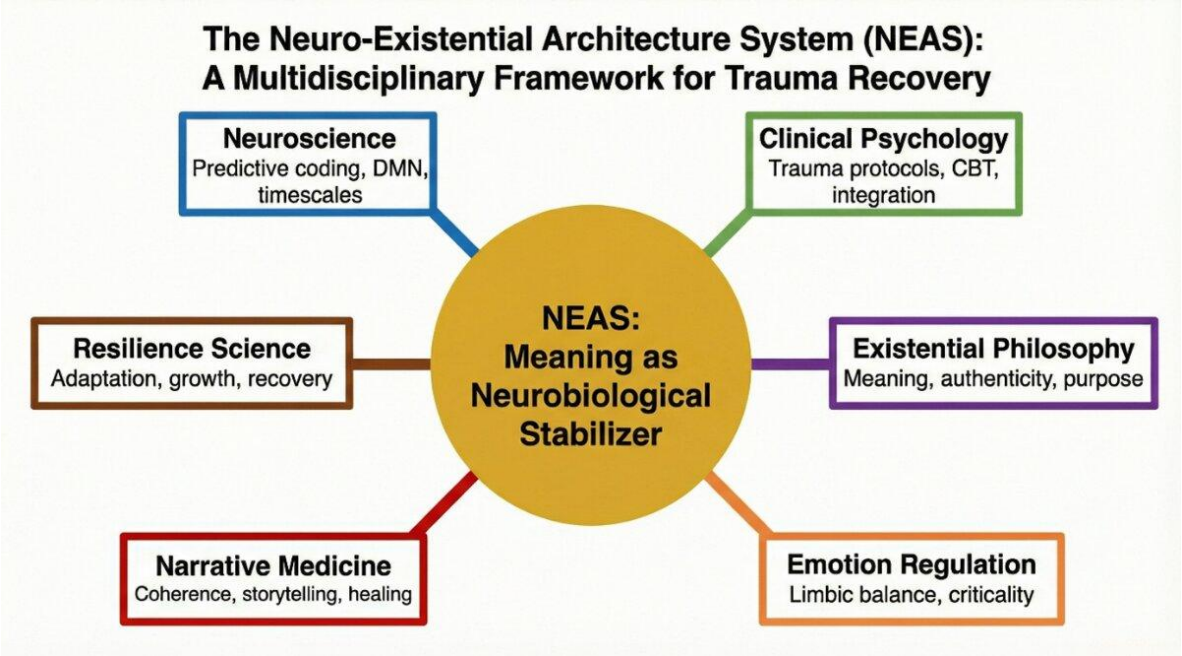

Figure 12. NEAS: Proposed Multidisciplinary Integration Framework.

Note. Radial diagram positioning NEAS as hypothesized integrator across: Neuroscience (predictive coding, DMN, timescales), Clinical Psychology (trauma protocols, CBT),

 doi:10.20944/preprints202602.1324.v1

Existential Philosophy (meaning, authenticity), Emotion Regulation (limbic balance), Resilience Science (growth, adaptation), Narrative Medicine (coherence). Proposed applications: clinics, training, protocols.

Conceptual synthesis; empirical scope/integration pending validation.

Abbreviations: NEAS, Neuro-Existential Architecture System; DMN, default mode network; CBT, cognitive-behavioral therapy.

There are no known conflicts of interest associated with this article. Correspondence concerning this article should be addressed to Gerd Leidig

Section 9: GLOSSARY OF TERMS

A

Affective Logic (Ciompi). Integration of affect and logic in human information processing. Proposes that emotions are not separate from cognition but fundamental organizing principles that structure how the brain processes information, makes meaning, and responds to events. Trauma disrupts this integration, leaving the person logically disconnected from emotional reality or emotionally flooded without cognitive coherence. NEAS restoration integrates affective-cognitive systems through meaning-reconstruction.

Allostatic Load. The cumulative physiological wear and tear on the body from chronic stress, hyperarousal, and sustained defensive posturing. In trauma survivors, this load is high—the nervous system remains in a state of constant vigilance, metabolically expensive and exhausting. Somatic stabilization reduces allostatic load, freeing metabolic resources for higher-order processing (meaning-work, narrative integration).

Autorelational Window (ACW). The temporal span, typically 10–30 seconds in healthy individuals, over which the brain's highest regions (ventromedial prefrontal cortex, hippocampus) maintain correlation with their own prior activity. This self-correlation creates the subjective sense of "I am continuous across time." In trauma, ACW collapses—the person becomes trapped in an eternal present, unable to connect past, present, and future into a coherent narrative. NEAS Mechanism 3 (Spatiotemporal Coherence) works to extend and stabilize ACW through meaning-reconstruction and contemplative practice. Measured via resting-state fMRI autocorrelation.

Antifragile Resilience. Resilience that grows stronger through adversity, rather than merely enduring it. Contrasts with brittle resilience (white-knuckle survival that fragments under new stress). Antifragile resilience emerges when all four NEAS mechanisms are integrated, particularly Mechanism 4 (Witnessing-Space), permitting the person to face future challenges—loss, betrayal, mortality—without meaning-collapse. A concept from Nassim Taleb's *Antifragile* applied to trauma recovery.

Authenticity (Meaning). Quality of meaning that is integrated, flexible, embodied, and lived rather than rigid, defensive, or intellectualized. Authentic meaning aligns with behavior—a person's stated values and narratives are reflected in their actions. Authentic meaning can be questioned, revised, and refined without the person fragmenting. Depends on robust Mechanism 4 (Witnessing-Space) for stability. Operationalized via clinician ratings of narrative-affect congruence, flexibility under stress, embodied quality, and behavioral engagement.

B

Binding by Synchrony (Singer). Wolf Singer's theory that synchronized gamma-frequency (30–80 Hz) activity across distributed neural regions binds them into a unified conscious field. Mechanism by which different brain areas—prefrontal cortex, limbic system, temporal regions—achieve relational coherence. In NEAS, binding by synchrony instantiates Mechanism 4 (Witnessing-Space), creating the meta-aware perspective from which the person observes (rather than is possessed by) their own thoughts, emotions, and narratives. Measured via phase-locking index (PLI) in gamma band.

 doi:10.20944/preprints202602.1324.v1

Brittle Resilience. Resilience based on defensive suppression, rigid narrative, and white-knuckle endurance. The person appears recovered by external metrics—symptom reduction, functional capacity—but remains fragile. One new challenge, contradiction to meaning, or emotional trigger can unravel the entire structure. Typical outcome of standard trauma therapy (PE, CPT, EMDR) when Mechanism 4 (Witnessing-Space) is not explicitly cultivated. See Antifragile Resilience.

C

Catastrophic Mismatches (Narrative-Somatic). When a person's conscious narrative (e.g., "I am strong," "I have moved on") contradicts their body's response (hypervigilance, dissociation, panic, frozen immobility). This mismatch is a red flag for fragile or defensive meaning. Authentic meaning is congruent across narrative and somatic levels. Observable clinically through flat affect during meaning discussion, or somatic escalation when meaning-work activates body-level trauma.

Coherence (Meaning Dimension 1). The subjective sense that the world follows comprehensible patterns, that events have causal explanations, that one's experience makes sense. A trauma survivor achieves coherence when she can narrate her experience ("This happened because of these causes") without feeling that reality is incomprehensible or chaotic. Neurobiologically depends on the integrity of the brain's predictive hierarchy and the capacity of higher regions (vmPFC, DMN) to generate stable generative models. Operationalized via Narrative Coherence Index (NCI) and behavioral markers of narrative integration.

Cognitive Processing Therapy (CPT). Evidence-based trauma treatment combining psychoeducation, cognitive restructuring of trauma-related thoughts, and prolonged engagement with trauma memory to reduce PTSD symptoms. Addresses Mechanisms 1–3 of NEAS (hierarchical recalibration, emotional regulation, temporal coherence) but typically without explicit Mechanism 4 cultivation. Effect sizes for symptom reduction are large (Cohen's d = 1.0–2.0) but often plateau around 60–70% symptom reduction without existential integration.

Complex PTSD (C-PTSD). Disorder arising from prolonged, repeated trauma (childhood abuse, domestic violence, war, trafficking) characterized not only by core PTSD symptoms (intrusions, avoidance, hyperarousal) but also by affect dysregulation, negative self-perception, disrupted relationships, and existential disturbance. More severe, treatment-resistant than single-incident PTSD. NEAS particularly targets C-PTSD's existential fragmentation through all four mechanisms.

Contemplative Practice. Structured mental training (meditation, mindfulness, body-scan, loving-kindness) designed to develop meta-awareness and stabilize the witnessing perspective. In NEAS, contemplative practice is primary vehicle for cultivating Mechanism 4 (Witnessing-Space). Not merely stress-reduction or relaxation, but systematic development of capacity to observe one's own thoughts, emotions, and body sensations from a non-identified, spacious awareness. Trainable and developmental—capacity increases with sustained practice.

Cortical Midline Structures (CMS). Brain regions distributed along the midline of the cortex (medial prefrontal cortex, posterior cingulate, precuneus) that are central to self-referential processing and are major hubs of the Default Mode Network. These regions encode the self—one's values, identity, meaning, and narrative. Damage to or dysregulation of CMS is associated with loss of self-continuity, dissociation, and meaning-loss in trauma survivors.

Criticality (Emotional). In dynamical systems, the equilibrium operating at the phase boundary between order and chaos. Applied to the limbic system: optimal emotional function emerges when the Papez system (hope, agency, forward-drive) and Yakovlev system (caution, critical evaluation, reality-checking) oscillate fluidly around a stable meaning-center, rather than rigidly fixed or dysregulated swinging to extremes. At criticality, the person can hold high emotional intensity—grief, rage, joy—without fragmenting. Trauma collapses this oscillation into freeze or hyperarousal. NEAS Mechanism 2 restores criticality through meaning-mediated limbic balance.

D

 doi:10.20944/preprints202602.1324.v1

Default Mode Network (DMN). A brain network active during rest and self-referential processing, including ventromedial prefrontal cortex, posterior cingulate, precuneus, and medial temporal lobes. Central to narrative and identity processing. In healthy individuals, DMN integrates into a coherent self-representation. In trauma, DMN becomes fragmented—narrative coherence breaks down, self-continuity fractures. One primary target of NEAS Mechanism 1 (Hierarchical Recalibration) is DMN re-integration through meaning-reconstruction.

Defensive Meaning. Meaning that is rigid, denying, or dissociated rather than integrated and lived. A trauma survivor with defensive meaning might report "The trauma made me stronger" with flat affect and no access to grief. Or they might construct an overly neat, simple narrative that collapses when encountering real-world complexity or new loss. Defensive meaning lacks Mechanism 4 (Witnessing-Space)—it is identified-with rather than observed. Under stress, defensive meaning fragments. Contrasts with Authentic Meaning.

Dissociation. Disconnection or fragmentation of normal integration across memory, identity, consciousness, emotion, perception, behavior, control, or sensory-motor experience. In trauma, dissociation can be protective (allowing survival during overwhelming threat) but becomes maladaptive (freezing learning, fragmenting identity, preventing meaning-integration). NEAS addresses both somatic dissociation (Level 0, via nervous system regulation) and existential dissociation (Mechanism 4, via meta-awareness cultivation). Note: Healthy disidentification through Witnessing-Space is distinct from pathological dissociation.

Downward Causation. In hierarchical systems, the principle that higher levels send organizing signals downward that shape lower-level processes. In NEAS, meaning-priors at the highest semantic level send top-down organizing constraints that recalibrate emotional systems, temporal rhythms, and meta-awareness. However, causation is not only downward—somatic signals, emotional feedback, and temporal constraints propagate upward, creating reciprocal causality and dynamic equilibrium.

E

Emotional Criticality. See Criticality (Emotional).

Emotional Dysregulation. Difficulty modulating emotional intensity, sustaining emotional balance, or recovering emotional equilibrium after triggering events. In trauma, the limbic system becomes dysregulated—oscillation between Papez (hope) and Yakovlev (caution) systems collapses into freeze, hyperactivity, or chaotic fluctuation without center. NEAS Mechanism 2 restores regulation by anchoring oscillation around a stable meaning-center, permitting emotional intensity without collapse.

Existential Fulfillment. The sense that one's life has meaning, purpose, and significance independent of external achievement or relational success. Measured via Existential Fulfillment Scale (EFS). Higher EFS scores in trauma survivors are associated with lower depression, lower PTSD symptoms, and better long-term resilience. NEAS integrates existential fulfillment work throughout Levels 1–3, with Level 2 explicitly cultivating Mechanism 4 as the foundation for authentic fulfillment.

Existential Meaning. The deepest form of meaning—the sense that one's existence has inherent worth and significance, that life is worth living even in the face of suffering, loss, and mortality. Viktor Frankl distinguished between existential meaning (intrinsic value of being) and instrumental meaning (external achievement or relational success). Existential meaning is particularly damaged in complex trauma and is the primary target of NEAS Level 2 (Existential Meaning-Reconstruction) and Level 3 (Deep Meaning Integration).

Existential Resilience. See Antifragile Resilience. Resilience grounded in existential meaning and meta-awareness rather than in symptom suppression or defensive narrative. A person with existential resilience can face future adversity—loss, betrayal, mortality—while maintaining meaning-coherence and identity-integrity.

 doi:10.20944/preprints202602.1324.v1

Exposure Therapy (Prolonged Exposure, PE). Evidence-based trauma treatment combining psychoeducation, breathing training, imaginal exposure (repeated recounting of the trauma memory), and in-vivo exposure (approaching avoided situations). Primary mechanism of change is habituation and memory reconsolidation. Addresses NEAS Mechanisms 1–3 (narrative reconstruction, emotional processing, temporal integration) but without explicit Mechanism 4 cultivation. Typical effect size for symptom reduction Cohen's d = 1.2–1.8.

F

Fragmentation (Psychological). Breakdown of normal integration across psychological functions—identity, memory, narrative, emotion, volition. In severe trauma, fragmentation can manifest as dissociative identity disorder, fragmented self-sense, or what NEAS describes as failure of Mechanism 4 (Witnessing-Space). The person experiences themselves as multiple, incoherent, or unable to maintain a continuous sense of self. NEAS explicitly targets fragmentation prevention through Mechanism 4 development.

Free Energy Principle (Friston). Karl Friston's theoretical framework proposing that the brain minimizes "variational free energy"—essentially, prediction error plus complexity of internal models. The brain acts as a generative model, continuously predicting upcoming sensory input and updating predictions when errors occur. Trauma disrupts this prediction system—the generative model fails ("It should have been safe, but it wasn't"), flooding the system with unresolved prediction errors. NEAS Mechanism 1 (Hierarchical Recalibration) works through free-energy minimization by providing new top-down meaning-priors that recalibrate predictions.

G

Gamma Frequency / Gamma Synchrony (30–80 Hz). Rapid oscillations in brain electrical activity. High gamma synchrony across distributed regions indicates strong neural integration and information binding. In NEAS, gamma synchrony is the neurobiological mechanism of Witnessing-Space—inter-regional gamma binding creates the unified conscious field from which the person observes their experience. Measured via electroencephalography (EEG) phase-locking index (PLI) in gamma band.

Generative Model. In predictive coding, the brain's internal model of how the world works—what causes what, what is safe, what is dangerous. In trauma, generative models are shattered ("The world is not safe"; "People cannot be trusted"; "My body is not safe"). NEAS Mechanism 1 reconstructs generative models through meaning-priors that provide new top-down organizing principles for prediction.

Grounding. Techniques to anchor a dissociating or triggered person to the present moment through sensory engagement (touching objects, listening to sounds, feeling feet on ground) or attentional focus. Foundational to NEAS Level 0 (Sensorimotor Stabilization) and used throughout to support Mechanism 4 (Witnessing-Space) development—observing present-moment sensory experience from the witnessing perspective.

H

Hierarchical Predictive Processing / Hierarchy. The brain's organization as a cascade of levels from lowest (primary sensory regions processing raw data) to highest (prefrontal cortex generating abstract predictions about meaning, self, future). Information flows both bottom-up (sensory signals) and top-down (predictions refining what to attend to). Trauma flattens or fragments this hierarchy—predictions collapse, sensory data floods consciousness unfiltered. NEAS Mechanism 1 (Hierarchical Recalibration) restores hierarchical organization through meaning-priors that send top-down organizing signals.

Hippocampus. Brain region critical for episodic memory encoding and contextual framing of experience. In trauma, hippocampal function is often impaired—traumatic memory becomes fragmented, decontextualized, and re-experienced as present threat. Hippocampus is also crucial for

 doi:10.20944/preprints202602.1324.v1

extended temporal processing (ACW extension) and for integrating meaning-priors into narrative. NEAS targets hippocampal function through narrative-reconstruction work (Level 1, Mechanism 1) and meaning-reconstruction (Level 2, Mechanism 1).

I

Identified vs. Disidentified. In Mechanism 4 (Witnessing-Space), identified means "possessed by" one's thoughts, emotions, or narratives—unable to separate from them. Disidentified means "aware of" them from a witnessing perspective—able to observe them without being determined by them. This disidentification is not dissociation or avoidance, but integration through meta-awareness. A person can feel grief *and* observe their grief without being overwhelmed by it.

Infra-Slow Oscillations (ISOs, 0.01–0.1 Hz). Extremely slow rhythmic patterns in brain activity that structure and stabilize faster cognitive-emotional frequencies. Like a foundational bass note underlying a musical piece, ISOs provide temporal coherence to higher-frequency processing. In trauma, ISOs collapse, leading to temporal fragmentation and inability to hold emotional intensity. NEAS Mechanism 3 (Spatiotemporal Coherence) stabilizes ISOs through meaning-reconstruction and contemplative practice, creating a temporal container for emotional experience.

Interoception / Interoceptive Awareness. Perception of the body's internal state—heart rate, breathing, digestion, emotion-linked sensations. Trauma survivors often have disrupted interoception (hyperinteroception leading to false alarms, or hypo-interoception leading to disconnection). NEAS Level 0 (Sensorimotor Stabilization) includes somatic awareness work to restore accurate interoception. Healthy interoception provides upward signals that inform meaning-reconstruction and emotional balance (reciprocal causality in hierarchical systems).

Intrusive Memory / Intrusions. In PTSD, unwanted, involuntary re-experiencing of traumatic memories—flashbacks, nightmares, intrusive thoughts. Occur because the traumatic memory has not been properly contextualized and consolidated into autobiographical memory. NEAS Mechanism 1 (via narrative-reconstruction, Level 1) and Mechanism 3 (via temporal integration) target intrusive memories directly through trauma-focused exposure work.

J

Joint Attention. In relational neuroscience, the capacity for two people to focus on the same object or intention simultaneously, creating a shared mental space. In therapy, joint attention is foundational to therapeutic alliance and is amplified in NEAS through relational safety (Level 0) and throughout meaning-reconstruction work. Joint attention neurobiologically involves synchronized neural rhythms (similar to gamma binding in Mechanism 4) across therapist and client.

K

Kindling. In neuroscience and psychiatry, the phenomenon where repeated subclinical stress activations gradually lower the threshold for full symptom activation, so that eventually minimal triggers produce major symptom episodes. In complex trauma, kindling is common—repeated trauma exposures, or accumulated smaller stressors, gradually sensitize the system. NEAS addresses kindling by raising the resilience threshold through all four mechanisms, particularly Mechanism 4 (Witnessing-Space) which permits stress activation without system collapse.

L

Legacy Work. Existential therapy technique in which the client articulates what mark, meaning, or contribution they wish to leave in the world and in others' lives. Particularly relevant for trauma survivors who have confronted mortality or loss. In NEAS Level 3 (Deep Meaning Integration), legacy work deepens existential meaning by connecting personal recovery to broader purpose and generativity. Related to posttraumatic growth and existential fulfillment.

Limbic System. Evolutionary older brain structures (amygdala, hippocampus, hypothalamus, insula) involved in emotion, threat-detection, memory, and motivated behavior. The Papez system

 doi:10.20944/preprints202602.1324.v1

(hope, forward-drive, agency) and Yakovlev system (caution, evaluation, protection) are the two primary limbic circuits. In trauma, limbic regulation is dysregulated. NEAS Mechanism 2 (Emotional Criticality) specifically targets limbic re-balance through meaning-mediated oscillation.

Logotherapy. Viktor Frankl's existential psychotherapy approach based on the principle that the human primary motivation is the search for meaning. Logotherapy techniques include exploring meaning through life-meaning questions, discovering purpose through contribution and creative work, and finding meaning even in unavoidable suffering. NEAS Level 3 (Deep Meaning Integration) incorporates logotherapy as the primary modality for existential meaning-reconstruction.

M

Meaning-Centered Group Psychotherapy (MCGP). Breitbart and colleagues' structured group intervention for cancer patients and trauma survivors, focusing on existential meaning through guided discussion, legacy work, and spiritual exploration. MCGP has demonstrated sustained reductions in hopelessness (effect size d = 0.87–0.81 at 6-month follow-up) and improvements in posttraumatic growth. NEAS Level 2 incorporates MCGP format (optional group meetings) alongside individual existential meaning-work.

Meaning-Prior. In predictive coding, a stable, value-laden representation at the highest cortical levels that sends top-down organizing signals throughout the hierarchical predictive system. In healthy individuals, meaning-priors are relatively stable (e.g., "Life is meaningful," "I am valuable," "The world has order") and organize how threat is assessed, emotions are regulated, and narratives are constructed. In trauma, meaning-priors are shattered. NEAS Mechanism 1 is dedicated to meaning-prior reconstruction—installing new top-down organizing principles.

Medial Prefrontal Cortex (mPFC). See Ventromedial Prefrontal Cortex (vmPFC).

Meta-Awareness. Awareness of one's own awareness—the capacity to observe one's thoughts, emotions, sensations, and narratives from a witnessing perspective rather than being identified with them. Central to Mechanism 4 (Witnessing-Space). Meta-awareness is developed through contemplative practice and can transition from a state (achievable only in meditation) to a trait (baseline capacity throughout daily life). Measured via Toronto Mindfulness Scale (TMS) and gamma PLI.

Mindfulness. Present-moment, non-judgmental awareness of experience—thoughts, emotions, sensations, environment. In NEAS, mindfulness is foundational to Mechanism 4 (Witnessing-Space) cultivation. However, NEAS distinguishes between symptom-reduction mindfulness (stress management) and meta-awareness mindfulness (capacity for disidentified witnessing). The latter is more sophisticated and more directly addresses existential fragmentation.

Mortality Salience. Conscious or unconscious awareness of one's inevitable death. In trauma survivors, mortality salience is often heightened and dysregulated—either anxiously preoccupying or denied through defensive dissociation. In NEAS Level 3 (Deep Meaning Integration), mortality salience is engaged explicitly and therapeutically—helping the person integrate knowledge of death into a coherent, meaningful life perspective (part of existential resilience).

N

Narrative Coherence. The degree to which a person can construct and articulate a life story in which events follow causal logic, trauma is integrated (not dissociated), and past, present, and future are connected into a meaningful arc. Operationalized via Narrative Coherence Index (NCI). Narrative coherence is foundational to Mechanism 1 (Hierarchical Recalibration) and is primary work of NEAS Level 1 (Narrative Coherence). Distinct from narrative *rigidity*—authentic coherence is flexible and can accommodate new information.

Neural Synchrony. Coordinated activity across distributed neural regions. Low-frequency neural synchrony (e.g., theta, 4–8 Hz) supports memory binding; gamma synchrony (30–80 Hz) supports binding and conscious integration across regions. In trauma, neural synchrony is disrupted—regions fail to coordinate, information fragments. NEAS Mechanism 4 (Witnessing-

 doi:10.20944/preprints202602.1324.v1

Space) is neurobiologically instantiated through inter-regional gamma synchrony. Measured via phase-locking index (PLI).

Neuro-Existential Architecture System (NEAS). The integrated framework presented in this manuscript, proposing that meaning is a neurobiological organizing principle operating through four complementary mechanisms that stabilize the traumatized brain. NEAS integrates neuroscience (hierarchical predictive processing, temporal neuroscience, limbic dynamics, gamma binding), existential philosophy (Frankl, Yalom, Northoff), trauma-informed therapy (PE, CPT, somatic work), and contemplative science (meditation, mindfulness). See Four Mechanisms.

O

Operationalization. The process of translating an abstract construct (e.g., "meaning") into measurable, observable dimensions and indicators. NEAS operationalizes meaning into three dimensions (Coherence, Purpose, Significance) with specific self-report measures, behavioral markers, and neurobiological correlates. Operationalization allows abstract theory to be empirically tested and clinically monitored.

P

Papez System. One of the two primary limbic circuits, associated with forward-drive, hope, agency, motivation toward valued futures, and dopaminergic reward prediction. Named after James Papez. In trauma, Papez system activation often collapses, leaving the person without motivation or hope. NEAS Mechanism 2 (Emotional Criticality) works to reactivate Papez system through meaning-reconstruction, permitting oscillation between Papez (hope) and Yakovlev (caution) around a stable meaning-center.

Phenomenology / Phenomenological. The philosophical and scientific study of structures of conscious experience—how things appear to consciousness, what the lived experience of trauma, healing, or meaning feels like. NEAS is explicitly phenomenologically grounded alongside neuroscientific grounding, honoring both first-person experience and third-person neurobiology.

Phase-Locking Index (PLI). A measure (0–1 scale, higher = stronger) of phase synchronization between two oscillatory signals. Used to quantify inter-regional neural synchrony in specific frequency bands. In NEAS, gamma-band PLI is used to measure Mechanism 4 (Witnessing-Space) and meta-awareness development. Normal baseline gamma PLI ≈ 0.15–0.25; trauma-fragmented ≈ 0.08–0.12; therapeutic improvement toward ≈ 0.20–0.28.

Polyvagal Theory (Porges). Stephen Porges' theory of the vagus nerve's role in regulating threat-response and social engagement. The dorsal vagal (ancient) system mediates freeze and dissociation; the sympathetic system mediates fight-or-flight; the ventral vagal (newer) system mediates social engagement and calm arousal. Trauma often locks the system in dorsal vagal freeze or dysregulated sympathetic-dorsal cycling. Polyvagal-informed therapy (Level 0 of NEAS) restores ventral vagal tone and nervous system flexibility.

Posttraumatic Growth (PTG). Positive psychological changes—increased personal strength, new possibilities, deeper relationships, spiritual growth, appreciation of life—that can emerge after trauma recovery. Measured via Posttraumatic Growth Inventory (PTGI). PTG is distinct from symptom reduction; it requires meaning-integration and meta-awareness (Mechanisms 1 and 4). NEAS hypothesizes that authentic, durable PTG depends on all four mechanisms integrated.

Posterior Cingulate Cortex (PCC). A hub region of the Default Mode Network involved in self-referential processing and memory integration. In trauma, PCC dysfunction contributes to fragmented self-sense and narrative incoherence. NEAS Mechanism 1 targets PCC re-integration through meaning-reconstruction work that reconnects self-reference and narrative coherence.

Predictive Coding / Predictive Processing. The brain's fundamental operating principle: the brain is not a passive receiver of sensory input but an active generator of predictions about the world, continuously updating predictions when prediction errors occur. Trauma disrupts prediction—the brain's models of safety are violated, generating massive, unresolved prediction errors that persist as

 doi:10.20944/preprints202602.1324.v1

PTSD symptoms. NEAS Mechanism 1 works through predictive coding by installing new meaning-priors that generate new predictions and resolve errors. Theoretical foundation from Karl Friston.

Primary Outcome. In clinical research, the main measure of treatment efficacy. NEAS primary outcome is Sheehan Disability Scale (SDS) at 24 weeks and 12-month follow-up, supplemented by PCL-5 (PTSD symptom severity). Secondary outcomes include Posttraumatic Growth Inventory (PTGI), Meaning in Life Questionnaire (MLQ), and neurobiological measures (ACW, gamma PLI).

Prolonged Exposure (PE). See Exposure Therapy.

Purpose (Meaning Dimension 2). The sense that life has direction, that one's actions aim toward something that matters, and that the future holds meaningful possibility. Forward-looking and intentional, involving Papez system activation and reward circuitry. Operationalized via Meaning in Life Questionnaire (MLQ) Presence subscale and behavioral tracking of engagement in valued activities. Distinct from Coherence (intelligibility) and Significance (inherent worth).

Q

Quality-of-Life. Subjective sense of overall well-being across multiple life domains—relationships, work, health, spirituality, existential meaning. Measured via satisfaction scales (SWLS) and functional assessments (WHODAS). NEAS target variable—therapy success is not just symptom reduction but improvement in lived quality of life.

R

Randomized Controlled Trial (RCT). Gold-standard experimental design for testing treatment efficacy. Participants are randomly assigned to treatment or control conditions; outcomes are compared. NEAS includes a proposed multi-site RCT design (N=240) comparing four-level NEAS vs. standard three-level PE/CBT, with nested neuroimaging subsample (N=40/arm).

Reciprocal Causality / Reciprocal Regulation. In hierarchical systems, causality flows not only downward (higher levels organizing lower) but also upward (lower levels constraining higher). In NEAS, meaning-priors send downward organizing signals (Mechanism 1), but somatic signals send upward interoceptive information (Level 0); emotions feed back to modulate meaning-acceptance (Mechanism 2); temporal constraints determine which narratives are sustainable (Mechanism 3). This reciprocal dynamic creates stability and flexibility.

Recurrent Dynamics. The pattern of information cycling through and returning to the same neural networks, permitting integration, learning, and updating of models. Contrasts with feed-forward dynamics (one-way signal). Wolf Singer's recent work emphasizes recurrent dynamics as fundamental to consciousness, binding, and meaning-integration. NEAS Mechanism 4 (gamma binding via recurrent inter-regional synchrony) likely depends on robust recurrent dynamics.

Relapse. Return of PTSD symptoms or existential fragmentation after initial improvement. NEAS hypothesis: standard therapy without Mechanism 4 (Witnessing-Space) shows higher relapse rates because the system remains fragile. NEAS predicts lower relapse rates (10–15% vs. 20–25% for standard) at 12-month follow-up due to meta-awareness stabilization.

Relational Coherence Field. A concept developed within NEAS to describe the unified, integrative space created by inter-regional gamma binding (Mechanism 4). This field permits all three lower mechanisms (meaning, emotion, time) to function without fragmentation, even under stress. Not a physical space but a dynamic relational property of brain organization permitting flexible integration.

Resilience. Capacity to recover from adversity and maintain or restore psychological functioning. Classical models emphasize genetic predisposition, attachment security, social support. NEAS proposes that meaning-stabilization and meta-awareness (Mechanism 4) are equally crucial. Distinguishes between brittle resilience (defensive, vulnerable) and antifragile resilience (growing through adversity).

Resting-State fMRI. Functional neuroimaging while the person is at rest (not performing a task), measuring patterns of intrinsic neural activity and connectivity. Used to measure Default Mode

 doi:10.20944/preprints202602.1324.v1

Network coherence, ACW (via temporal autocorrelation), and inter-regional connectivity patterns. Primary neurobiological assessment method in NEAS study design.

S

Safety (Relational). The felt sense that the therapeutic relationship is secure, that the therapist is trustworthy, attuned, and able to contain the client's distress. Relational safety is prerequisite to all NEAS work (Level 0). Without safety, the nervous system remains in threat-detection mode, blocking access to higher processing necessary for meaning-work or contemplative practice.

Self-Referential Processing. Neural activity associated with thinking about oneself—one's values, identity, autobiography, meaning. Mediated by cortical midline structures (vmPFC, PCC, precuneus) and the Default Mode Network. Trauma disrupts self-referential processing, leaving the person with fragmented or distorted sense of self. NEAS Mechanism 1 restores healthy self-referential processing through meaning-reconstruction.

Semantic Level. In predictive coding, the highest level of the brain hierarchy encoding abstract meaning, values, and identity—answering questions like "Who am I?", "What matters?", "What does this mean?" versus sensory levels encoding raw sensory data. Trauma disrupts semantic-level processing, leaving the person unable to make meaning of their experience. NEAS Mechanism 1 operates at semantic level through meaning-priors reconstruction.

Sequence / Sequencing. In NEAS, the order in which the four levels of intervention are introduced: Level 0 (Sensorimotor Stabilization) → Level 1 (Narrative Coherence) → Level 2 (Existential Meaning-Reconstruction with explicit Mechanism 4) → Level 3 (Deep Meaning Integration). Sequence matters neurobiologically and clinically—a hyperaroused nervous system cannot meaningfully engage meaning-work. Three sequencing models (A Sequential, B Hybrid, C Top-Down-First) accommodate different baseline presentations.

Significance (Meaning Dimension 3). The sense that one's existence has inherent dignity and value, independent of achievement, relational success, or productivity. Deepest dimension of meaning. Neurobiologically depends on stable, continuous self-representation (extended ACW) and integration of self-worth across time and circumstances. Operationalized via Existential Fulfillment Scale (EFS) and clinician observation of self-worth and dignity markers.

Somatic Experience / Somatic Experiencing (SE). Peter Levine's trauma therapy approach emphasizing nervous system regulation through awareness and completion of trauma-interrupted defensive responses (freeze recovery, discharge of blocked activation energy). Addresses Level 0 (Sensorimotor Stabilization) of NEAS. Effective for hyperarousal reduction but typically without explicit existential meaning-work.

Spatiotemporal Coherence. The integration of spatial and temporal dimensions of experience—the ability to hold past, present, and future simultaneously and to maintain emotional coherence across time. Depends on extended ACW and stabilized ISOs (Mechanism 3). Permits narrative continuity and emotional resilience across time. Without spatiotemporal coherence, the person remains trapped in present-moment fragmentation or overwhelmed by intrusive past.

Stress-Testing / Stress Resilience. In NEAS RCT design, measurement of system durability under real-world stressors. Participants are assessed for stressors occurring weeks 24–32 post-baseline; PCL-5 is re-administered at 6-month and 12-month to measure whether stress triggers symptom rebound. NEAS hypothesis: four-level intervention shows smaller PCL-5 increases under stress (5 points) vs. standard three-level (5–10 points), demonstrating superior stability.

System Re-Coherence. NEAS outcome—the restoration of hierarchical brain organization to functional, flexible integration across all levels: somatic (Level 0), semantic-narrative (Mechanism 1), emotional (Mechanism 2), temporal-rhythmic (Mechanism 3), and meta-aware (Mechanism 4). Re-coherence is measurable neurobiologically (ACW extension, gamma synchrony, DMN integration) and clinically (symptom reduction, narrative integration, functional engagement, life satisfaction, posttraumatic growth).

---

 doi:10.20944/preprints202602.1324.v1

T

Temporal Continuity. The subjective sense of "I am continuous across time," dependent on ACW extension and ISO stabilization (Mechanism 3). Permits coherent narrative spanning past, present, future. In trauma, temporal continuity collapses—the person becomes trapped in eternal present or fragmented across disconnected moments. Restored through Mechanism 3 work: narrative-reconstruction, meaning-based temporal framing, contemplative practice.

Temporal Neuroscience (Northoff). Georg Northoff's theoretical framework emphasizing that consciousness and selfhood depend fundamentally on temporal dynamics—the brain's ability to integrate across multiple timescales (from milliseconds to hours). Trauma disrupts temporal dynamics; recovery requires restoration of temporal coherence. Central theoretical foundation for NEAS Mechanism 3 (Spatiotemporal Coherence).

Therapeutic Alliance. The collaborative relationship between therapist and client—mutual trust, agreement on goals, and emotional connection. Strong alliance predicts better treatment outcomes. NEAS emphasizes relational safety and joint attention throughout all levels, particularly Level 0 and Level 2 (existential meaning-work requires deep relational trust).

Toronto Mindfulness Scale (TMS). 13-item self-report instrument measuring non-judgmental present-moment awareness and open-monitoring meditation quality. Higher scores indicate greater mindfulness and meta-awareness development. In NEAS, TMS is used as a behavioral proxy for Mechanism 4 (Witnessing-Space) development alongside neurobiological measures (gamma PLI).

Trauma. Overwhelming experience of threat, loss, or violation that exceeds the person's capacity to process and integrate. Can be acute (single incident) or complex (prolonged, repeated). Neurobiologically characterized by fragmentation of hierarchical processing, dysregulation of limbic and temporal systems, and loss of meaning-coherence. NEAS targets all neurobiological levels of trauma impact.

Trauma-Focused Cognitive Behavioral Therapy (TF-CBT). Evidence-based approach combining psychoeducation, trauma-focused cognitive restructuring, imaginal exposure to trauma memory, in-vivo behavioral activation, and stress-management skills. Effective for PTSD symptom reduction. Addresses Mechanisms 1–3 of NEAS. Typical effect size Cohen's d = 1.2–1.5 for symptom reduction.

Transcendent Purpose. Purpose that extends beyond individual or relational goals to connect with something larger—spiritual practice, service to others, contribution to humanity, alignment with ecological or cosmic order. In NEAS Level 3 (Deep Meaning Integration), transcendent purpose is explored as deepening existential meaning and resilience. Related to posttraumatic growth and spiritual transformation.

U

Upward Causation. See Reciprocal Causality.

V

Ventromedial Prefrontal Cortex (vmPFC). Brain region in medial prefrontal cortex, heavily connected to limbic system (amygdala, hippocampus, insula). Central to self-referential processing, emotional evaluation, value representation, and meaning-encoding. Primary region for meaning-prior representation in NEAS Mechanism 1. Dysfunction in vmPFC is associated with meaning-loss, emotional dysregulation, and identity fragmentation in trauma. Primary neurobiological target of meaning-reconstruction work.

Vulnerability-Shame Entanglement. In trauma, the fusion of legitimate vulnerability (human, natural, universal) with shame (self-blame, unworthiness, wrongness). A trauma survivor may think "I am vulnerable = I am weak/bad." NEAS meaning-work disentangles these: "I am vulnerable AND this vulnerability is intrinsically human AND I can carry it with dignity." This is Coherence dimension of Mechanism 1.

W

 doi:10.20944/preprints202602.1324.v1

Witnessing-Space. Novel contribution of NEAS—a neurobiologically instantiated capacity for non-identified awareness, operationalized as inter-regional gamma synchrony (Binding by Synchrony). Witnessing-Space permits the person to observe their own thoughts, emotions, narratives, and body sensations from a spacious, non-possessed position. This is Mechanism 4, the meta-level that holds and integrates Mechanisms 1–3. Trainable through contemplative practice. Central to antifragile resilience.

World Assumptions. According to trauma theory, trauma shatters fundamental assumptions about the world (it is safe, people are trustworthy, the future is open). Meaning-reconstruction involves updating and rebuilding world assumptions into a coherent, realistic (not naive) framework. Related to Coherence dimension of Mechanism 1.

Y

Yakovlev System. One of the two primary limbic circuits, associated with caution, critical evaluation, reality-checking, protective restraint, and reference to the past (what has threatened before). Named after Paul Yakovlev. In trauma, Yakovlev system often dominates (freeze, hypervigilance, protective rigidity). NEAS Mechanism 2 works to restore dynamic oscillation between Yakovlev (caution, realism) and Papez (hope, forward-drive) around a stable meaning-center, permitting both protection and growth.

Z

Zero Point. In existential psychology and contemplative traditions, the non-dual awareness "before" subject-object distinction, from which witnessing emerges. Related to Witnessing-Space (Mechanism 4) and describes the phenomenological quality of meta-awareness—a point of awareness that is not identified with content (thoughts, emotions) but from which content is observed.

Section 10: ABBREVIATIONS

Abbreviation	Full Term
ACW	Autorelational Window
BBS	Binding by Synchrony
C-PTSD	Complex Posttraumatic Stress Disorder
CBT	Cognitive-Behavioral Therapy
CMS	Cortical Midline Structures
CPT	Cognitive Processing Therapy
DMN	Default Mode Network
EEG	Electroencephalography
EFS	Existential Fulfillment Scale
EMDR	Eye Movement Desensitization and Reprocessing
fMRI	Functional Magnetic Resonance Imaging

 doi:10.20944/preprints202602.1324.v1

Abbreviation	Full Term
Hz	Hertz (cycles per second)
ICC	Intraclass Correlation Coefficient
ISOs	Infra-Slow Oscillations
ITS	Intrinsic TimescaleS
MCGP	Meaning-Centered Group Psychotherapy
mPFC	Medial Prefrontal Cortex
MLQ	Meaning in Life Questionnaire
NEAS	Neuro-Existential Architecture System
NCI	Narrative Coherence Index
PE	Prolonged Exposure
PLI	Phase-Locking Index
PTSD	Posttraumatic Stress Disorder
PTGI	Posttraumatic Growth Inventory
PCL-5	PTSD Checklist for DSM-5
RCT	Randomized Controlled Trial
SDS	Sheehan Disability Scale
SE	Somatic Experiencing
TMS	Toronto Mindfulness Scale
TF-CBT	Trauma-Focused Cognitive-Behavioral Therapy
vmPFC	Ventromedial Prefrontal Cortex
WEIRD	Western, Educated, Industrialized, Rich, Democratic
WHODAS	World Health Organization Disability Assessment Schedule

Section 11: USE OF ARTIFICIAL INTELLIGENCE (AI) DISCLOSURE

In accordance with current ethical and editorial standards for scientific publishing—including the International Committee of Medical Journal Editors (ICMJE) Recommendations (2024), the Committee on Publication Ethics (COPE) AI guidelines, and publisher-specific policies (e.g., Nature Portfolio, APA)—the author discloses the use of generative artificial intelligence (AI) as a supportive tool during manuscript preparation.

 doi:10.20944/preprints202602.1324.v1

Specifically, Perplexity.ai (version Pro, accessed between January–December 2025) was employed for the following *permissible* tasks:

1. Conceptual scaffolding and structural refinement: Assisting in the organization of theoretical arguments and logical flow across sections.
2. Iterative development of schematic figures: Generating preliminary visual drafts for Figures 1, 3, 4, and 7 based on the author's explicit conceptual input; all final diagrams were manually revised and validated by the author.
3. Linguistic polishing and translation support: Aiding in the transfer of the original German manuscript into precise academic English, with all phrasing, terminology, and stylistic choices critically reviewed and approved by the author.

The author affirms that:

- No AI system contributed to the original theoretical synthesis, hypothesis generation, study design, or interpretation of data.
- All scientific claims, citations, neurobiological mechanisms (e.g., ACW, gamma synchrony, Witnessing-Space), and clinical protocols reflect the author's sole intellectual work.
- AI tools were used strictly as textual and graphical aids, consistent with the ICMJE's position that AI cannot fulfill authorship criteria (substantial contributions to conception, analysis, or accountability).
- The author assumes full responsibility for the integrity, accuracy, and originality of the entire manuscript.

References

1. Aston-Jones, G., & Cohen, J. D. (2005). An integrative theory of locus coeruleus-noradrenaline function: Adaptive gain and optimal performance. *Annual Review of Neuroscience*, *28*, 403–450. https://doi.org/10.1146/annurev.neuro.28.061604.135709
2. Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. Assessment, 13(1), 27–45. https://doi.org/10.1177/1073191105283504
3. Barrett, L. F., & Bar, M. (2009). See it with feeling: affective predictions during object perception. Philosophical transactions of the Royal Society of London. Series B, Biological sciences, 364(1521), 1325–1334. https://doi.org/10.1098/rstb.2008.0312
4. Beggs, J. M., & Plenz, D. (2003). Neuronal avalanches in neocortical circuits. The Journal of neuroscience : the official journal of the Society for Neuroscience, 23(35), 11167–11177. https://doi.org/10.1523/JNEUROSCI.23-35-11167.2003
5. Bluck, S., & Habermas, T. (2000). The life story schema. Motivation and Emotion, 24(2), 121–147. https://doi.org/10.1023/A:1005615331901
6. Bouret, S., & Sara, S. J. (2005). Network reset: A simplified overarching theory of locus coeruleus noradrenaline function. Trends in Neurosciences, 28(11), 574–582. https://doi.org/10.1016/j.tins.2005.09.002
7. Breitbart, W., Rosenfeld, B., Pessin, H., Applebaum, A., Kulikowski, J., & Lichtenthal, W. G. (2015). Meaning-centered group psychotherapy: an effective intervention for improving psychological well-being in patients with advanced cancer. Journal of clinical oncology: official journal of the American Society of Clinical Oncology, 33(7), 749–754. https://doi.org/10.1200/JCO.2014.57.2198
8. Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network: Anatomy, function, and relevance to disease. Annals of the New York Academy of Sciences, 1124, 1–38. https://doi.org/10.1196/annals.1440.011
9. Ciompi L. (1997). The concept of affect logic: an integrative psycho-socio-biological approach to understanding and treatment of schizophrenia. Psychiatry, 60(2), 158–170. https://doi.org/10.1080/00332747.1997.11024795
10. Cloitre M. (2021). Complex PTSD: assessment and treatment. European Journal of Psychotraumatology, 12(Suppl), 1866423. https://doi.org/10.1080/20008198.2020.1866423

 doi:10.20944/preprints202602.1324.v1

11. Dana, D. (2018). The polyvagal theory in therapy: Engaging the rhythm of regulation. W.W. Norton & Company.
12. Davidson, R. J., & Begley, S. (2012). The emotional life of your brain: How its unique patterns affect the way you think, feel, and live—and how you can change them. Hudson Street Press.
13. Ecker, B., Ticic, R., & Hulley, L. (2012). Unlocking the emotional brain: Neurobiology of emotion and trauma healing. Routledge.
14. Foa, E. B. (2011). Prolonged exposure therapy: Past, present, and future. Depression and Anxiety, 28(12), 1043–1047. https://doi.org/10.1002/da.20907
15. Foa, E. B., Hembree, E. A., Cahill, S. P., Rauch, S. A., Riggs, D. S., Feeny, N. C., & Yadin, E. (2005). Randomized trial of prolonged exposure for posttraumatic stress disorder with and without cognitive restructuring: outcome at academic and community clinics. Journal of consulting and clinical psychology, 73(5), 953–964. https://doi.org/10.1037/0022-006X.73.5.953
16. Ford, J. D., & Courtois, C. A. (2014). Complex PTSD, affect dysregulation, and borderline personality disorder. Borderline personality disorder and emotion dysregulation, 1, 9. https://doi.org/10.1186/2051-6673-1-9
17. Frankl, V. E. (2006). Man's search for meaning. Beacon Press. (Original work published 1946)
18. Friston, K. (2010). The free-energy principle: A unified brain theory? Nature Reviews Neuroscience, 11(2), 127–138. https://doi.org/10.1038/nrn2787
19. Friston, K. Computational psychiatry: from synapses to sentience. Mol Psychiatry 28, 256–268 (2023). https://doi.org/10.1038/s41380-022-01743-z
20. Hohwy, J. (2013). The predictive mind. Oxford University Press.
21. Keilholz, S. D., Magnuson, M. E., Pan, W. J., Willis, M., & Thompson, G. J. (2013). Dynamic properties of functional connectivity in the rodent. Brain connectivity, 3(1), 31–40. https://doi.org/10.1089/brain.2012.0115
22. Knyazev, G. G., Savostyanov, A. N., Bocharov, A. V., & Rudych, P. D. (2020). The default mode network in self- and other-referential processing: Effect of cultural values. Culture and Brain, 8(2), 111–131. https://doi.org/10.1007/s40167-020-00094-2
23. Längle, A., Orgler, C., & Kundi, M. (2003). The Existence Scale: A new approach to assess the ability to find personal meaning in life and to reach existential fulfilment. European Psychotherapy, 4(1), 135–151.
24. Leidig, G. (2026, January 20). Proposed mechanisms of existential resilience: A heuristic framework integrating free energy principle, affective criticality, and spatiotemporal neuroscience. Preprints. https://doi.org/10.20944/preprints202601.1426.v1
25. Levine, P. A. (2015). Trauma and memory: Brain and body in a search for the living past. North Atlantic Books.
26. Luthar, S. S. (2006). Resilience in development: A synthesis of research across five decades. In D. Cicchetti & D. J. Cohen (Eds.), Developmental psychopathology: Risk, resilience, and intervention (3rd ed., Vol. 4, pp. 739–795). Wiley. https://doi.org/10.1002/9780470939406.ch20
27. Lutz, A., Dunne, J. D., & Davidson, R. J. (2007). Meditation and the neuroscience of consciousness: An introduction. In P. D. Zelazo, M. Moscovitch, & E. Thompson (Eds.), The Cambridge handbook of consciousness (pp. 499–551). Cambridge University Press. https://doi.org/10.1017/CBO9780511816789.020
28. Lutz, A., Greischar, L. L., Rawlings, N. B., Ricard, M., & Davidson, R. J. (2004). Long-term meditators self-induce high-amplitude gamma synchrony during mental practice. Proceedings of the National Academy of Sciences, 101(46), 16369–16373. https://doi.org/10.1073/pnas.0407401101
29. Martela, F., & Steger, M. F. (2016). The three meanings of meaning in life: Distinguishing coherence, purpose, and significance. Journal of Positive Psychology, 11(5), 531–545. https://doi.org/10.1080/17439760.2015.1137623
30. Masten, A. S. (2001). Ordinary magic: Resilience processes in development. American Psychologist, 56(3), 227–238. https://doi.org/10.1037/0003-066X.56.3.227
31. McEwen, B. S. (2007). Physiology and neurobiology of stress and adaptation: Central role of the brain. Physiological Reviews, 87(3), 873–904. https://doi.org/10.1152/physrev.00041.2006

 doi:10.20944/preprints202602.1324.v1

32. McFarlane, A. C., & Yehuda, R. (2000). Resilience, vulnerability, and the course of posttraumatic reactions. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), Traumatic stress: The effects of overwhelming experience on mind, body, and society (pp. 155–181). Guilford Press.
33. Melloni, L., Schwiedrzik, C. M., Muller, N., Rodriguez, E., & Singer, W. (2021). The role of oscillations in the self and other distinction: A computational perspective. Frontiers in Neuroscience, 15, 742274. https://doi.org/10.3389/fnins.2021.742274
34. Northoff, G. (2014). Neuro-philosophy and the healthy mind: Learning from the unwell brain. W.W. Norton & Company.
35. Northoff, G., & Bermpohl, F. (2004). Cortical midline structures and the self. Trends in Cognitive Sciences, 8(3), 102–107. https://doi.org/10.1016/j.tics.2004.01.001
36. Northoff, G., Bermpohl, F., & Schoenegg, F. (2020). How does our brain constitute our self? A neurophilosophical approach and empirical evidence. Journal of Consciousness Studies, 27(1–2), 86–109.
37. 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
38. Porges, S. W. (2021). The polyvagal theory: Neurophysiological foundations of emotions, attachment, communication, and self-regulation (10th anniversary ed.). W. W. Norton & Company.
39. Powers, M. B., Halpern, J. M., Ferenschak, M. P., Gillihan, S. J., & Foa, E. B. (2010). A meta-analytic review of psychological interventions for posttraumatic stress disorder. Psychiatric Services, 61(12), 1166–1172. https://doi.org/10.1176/ps.2010.61.12.1166
40. Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. Proceedings of the National Academy of Sciences, 98(2), 676–682. https://doi.org/10.1073/pnas.98.2.676
41. Raichle, M. E., & Snyder, A. Z. (2007). A default mode of brain function: A brief history of an evolving idea. NeuroImage, 37(4), 1083–1090. https://doi.org/10.1016/j.neuroimage.2007.02.041
42. Resick, P. A., Monson, C. M., & Chard, K. M. (2016). Cognitive processing therapy for PTSD: A comprehensive manual. Guilford Press.
43. Rutter, M. (1985). Resilience in the face of adversity: Protective factors and resistance to psychiatric disorder. British Journal of Psychiatry, 147, 598–611. https://doi.org/10.1192/bjp.147.6.598
44. Schauer, M., & Schauer, E. (2010). Dissociation following traumatic stress: Etiology and treatment. Frontiers in Psychology, 1, Article 12. https://doi.org/10.3389/fpsyg.2010.00012
45. Shansky, R. M., Hamo, C., Hof, P. R., McEwen, B. S., & Morrison, J. H. (2009). Stress-induced dendritic remodeling in the prefrontal cortex is circuit specific. Cerebral cortex (New York, N.Y. 1991), 19(10), 2479–2484. https://doi.org/10.1093/cercor/bhp003
46. Singer, W. (1999). Neuronal synchrony: A versatile code for the definition of relations? Neuron, 24(1), 49–65. https://doi.org/10.1016/S0896-6273(00)80821-1
47. Singer, W. (2021). Recurrent dynamics in the cerebral cortex: Integration of sensory evidence with stored knowledge. Proceedings of the National Academy of Sciences, 118(33), e2101043118. https://doi.org/10.1073/pnas.2101043118
48. Steger, M. F., & Frazier, P. (2005). Meaning in life: One link in the chain from religiousness to well-being. Journal of Counseling Psychology, 52(4), 574–582. https://doi.org/10.1037/0022-0167.52.4.574
49. 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
50. Strogatz, S. H. (2018). Nonlinear dynamics and chaos: With applications to physics, biology, chemistry, and engineering (3rd ed.). CRC Press.
51. Taleb, N. N. (2012). Antifragile: Things that gain from disorder. Random House.
52. Tallon-Baudry, C., & Bertrand, O. (1999). Oscillatory gamma activity in humans and its role in object representation. Trends in Cognitive Sciences, 3(4), 151–162. https://doi.org/10.1016/S1364-6613(99)01299-1
53. Tang, Y.-Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. Nature Reviews Neuroscience, 16(4), 213–225. https://doi.org/10.1038/nrn3916

 doi:10.20944/preprints202602.1324.v1

54. Tedeschi, R. G., & Calhoun, L. G. (2004). Posttraumatic growth: Conceptual foundations and empirical evidence. Psychological Inquiry, 15(1), 1–18. https://doi.org/10.1207/s15327965pli1501_01
55. Tschacher, W., & Haken, H. (2007). Detecting psychotherapeutic change by nonlinear dynamical systems (NDS). Psychotherapy Research, 17(3), 305–319.
56. Tucker, D. M., & Luu, P. (2023). Adaptive control of functional connectivity: Dorsal and ventral limbic divisions regulate the dorsal and ventral neocortical networks. Cerebral Cortex, 33(12), 7870–7895. https://doi.org/10.1093/cercor/bhad085
57. 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
58. van der Kolk, B. (2014). The body keeps the score: Brain, mind, and body in the healing of trauma. Penguin Books.
59. van der Spek, N., Vos, J., van Uden-Kraan, C. F., Breitbart, W., Cuijpers, P., Holtmaat, K., Witte, B. I., Tollenaar, R. A. E. M., & Verdonck-de Leeuw, I. M. (2017). Efficacy of meaning-centered group psychotherapy for cancer survivors: a randomized controlled trial. Psychological medicine, 47(11), 1990–2001. https://doi.org/10.1017/S0033291717000447
60. Werner, E. E., & Smith, R. S. (2001). Journeys from childhood to midlife: Risk, resilience, and recovery. Cornell University Press.
61. White, M., & Epston, D. (1990). Narrative means to therapeutic ends. W.W. Norton & Company.
62. Yalom, I. D. (2008). Staring at the sun: Overcoming the terror of death. Jossey-Bass.