

Review

Not peer-reviewed version

---

# From World-Brain Alignment to Network Dysfunction: A Spatiotemporal Framework for Precision Psychiatry

---

[Gerd Leidig](#)\*

Posted Date: 24 September 2025

doi: 10.20944/preprints202509.1971.v1

Keywords: spatiotemporal psychiatry; active inference; default mode network; precision psychiatry; common currency; world-brain problem; criticality; neurodynamics



Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a Creative Commons CC BY 4.0 license, which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Review

# From World-Brain Alignment to Network Dysfunction: A Spatiotemporal Framework for Precision Psychiatry

Gerd Leidig

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

Abstract

Contemporary psychiatry faces the challenge of overcoming the significant heterogeneity within existing diagnostic categories. Mechanistic, transdiagnostic models are crucial for the development of genuine precision psychiatry. This article proposes a novel, integrative multi-scale model that conceptualizes mental health and illness as the result of the brain's dynamic alignment with its environment. We argue that spatiotemporal dynamics represent the "common currency" in this world-brain relation (Northoff). The mechanism that accomplishes this alignment is Active Inference, maintained by a critical balance between a predictive, excitatory (E) and a corrective, inhibitory (I) control system (Friston, Tucker & Luu). A dysregulation of this mechanism manifests at the macroscopic level in the observable imbalances of large-scale brain networks such as the Default Mode Network (DMN). By defining pathology as a failure of spatiotemporal alignment—which manifests in rigid ("sub-critical") or chaotic ("super-critical") states—our framework provides a causal chain from the fundamental brain-environment relationship to the clinical symptom. This redefinition of pathology as a dynamic 'mal-alignment' simultaneously illuminates the path to healing: a targeted process of restoring this very alignment, leading from manifest network dysfunction back to mental health. We discuss the implications of this approach for defining transdiagnostic biotypes and developing dynamics-based therapies.

**Keywords:** spatiotemporal psychiatry; active inference; default mode network; precision psychiatry; common currency; world-brain problem; criticality; neurodynamics

---

## Public Significance Statement

This paper challenges the conventional view of mental illness as a "chemical imbalance" or a "broken" brain circuit. We propose a new framework that understands mental suffering as a fundamental "desynchronization" between the brain's internal rhythms and the rhythms of the surrounding world. This perspective helps explain why conditions like depression can feel like being "stuck in time," while psychosis can feel chaotic and fragmented. By reframing mental illness as a dynamic problem of timing and alignment, our model opens the door to developing new therapies aimed at helping the brain get back "in sync" with the world, offering a more holistic and personalized path to recovery.

## Introduction

Psychiatry is at a critical juncture. While neuroscience advances our understanding of the brain at an unprecedented pace, clinical practice continues to grapple with diagnostic constructs rooted in the descriptive phenomenology of the 19th century. This conceptual gap between what we know about the brain and how we classify mental suffering inhibits the development of more effective, personalized treatments. To close this gap, a fundamental paradigm shift is required: away from mere symptom description and toward a mechanistic understanding of the dynamic processes underlying

human experience. This article proposes such a mechanistic framework. We argue that mental health and illness can be best understood as the result of the brain's dynamic, spatiotemporal alignment with its environment.

## The Limits of Descriptive Nosology

The current pillars of psychiatric diagnostics, the Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD), were the result of a necessary historical step. With the publication of DSM-III in 1980, an "atheoretical," purely descriptive approach was deliberately chosen to overcome the lack of diagnostic reliability of earlier, often psychoanalytically influenced systems (American Psychiatric Association, 1980). This approach succeeded in establishing a reliable, standardized language within the global clinical community (American Psychiatric Association, 2013). However, this gain in reliability was purchased at a significant cost to validity. Today, its utility is hitting conceptual limits that are becoming increasingly apparent.

Because these systems classify disorders based on symptom clusters without making a well-founded statement about the underlying etiology or pathophysiology, they lead to a fundamental problem: the immense biological and phenomenological heterogeneity within single diagnostic categories (Insel et al., 2010). The most prominent example is Major Depressive Disorder (MDD). According to DSM-5 criteria, there are hundreds of different symptom combinations that can all lead to the same diagnosis. Theoretically, it is possible for two individuals diagnosed as "depressed" to share not a single symptom (Fried & Nesse, 2015). This diagnostic imprecision is not merely an academic subtlety; it has serious clinical consequences. It largely explains why response rates to antidepressants are often unsatisfactory, the development of new psychotropic drugs has stagnated for decades, and why it has so far been impossible to identify robust biomarkers for most psychiatric disorders. The "one-size-fits-all" principle that follows from categorical diagnostics is incompatible with the biological realities of the brain. High rates of comorbidity may be less an expression of multiple, independent disease entities and more an artifact of overlapping, non-specific symptom criteria.

## The Need for a Mechanistic Framework

In response to this crisis, a consensus is growing that progress is only possible through the development of transdiagnostic, mechanistic models. In this context, "mechanistic" means more than just the neuroanatomical localization of symptoms—an approach aptly criticized as "neophrenology." It requires an understanding of the causal, dynamic processes that explain how and why certain functions become unbalanced. Initiatives like the National Institute of Mental Health's Research Domain Criteria (RDoC) aim to free research from the constraints of DSM categories and focus instead on fundamental functional dimensions relevant across different disorders (Cuthbert & Insel, 2013). RDoC proposes a matrix in which constructs like "Negative Valence Systems" or "Cognitive Systems" are examined across various levels of analysis—from genes and molecules to neural circuits, behavior, and self-reports.

This multi-scale approach is groundbreaking, yet it requires an overarching theory that connects these different levels. Such a framework must go beyond the mere identification of dysfunctional circuits. It must find a "common currency," a language that allows for the description of the cascade from gene-environment interaction through neural dynamics to subjective experience and behavior, thereby closing the explanatory gap between the levels of analysis.

## A Multi-Scale, Spatiotemporal Approach

This article proposes that this "common currency" is to be found in spatiotemporal dynamics. We draw on the fundamental conceptual shift proposed by Northoff: from the classic, Cartesian "mind-body problem" to the "world-brain problem" (Northoff, 2023). From this perspective, the

brain is not an isolated information-processing organ enclosed in the skull that passively reacts to stimuli. Rather, it is a profoundly neuro-ecological system whose primary function is to continuously align with and embed itself in its environment through anticipation and action.

Mental phenomena, therefore, do not arise in the brain alone but from the relational dynamics between the intrinsic spatiotemporal structure of the brain (e.g., its neural oscillations and their nested frequencies) and the temporal structure of the world (e.g., rhythms, sequences, causalities). Mental health is the state of a successful, flexible “alignment” of these two dynamic systems—a state in which the brain’s internal predictive models are adequately attuned to the statistical regularities of the environment. Psychopathology, in contrast, is the result of a fundamental “mal-alignment.” One can imagine it like an orchestral instrument that loses its tuning and can no longer play harmoniously with the rest of the ensemble. The brain loses its ability to coherently couple its internal dynamics with those of the environment, leading to rigid (as in depression) or chaotic, fragmented (as in psychosis) patterns of experience and behavior.

## Outline of the Proposed Synthesis

To substantiate this spatiotemporal framework, this article will weave together three complementary theoretical levels into a new synthesis that describes a causal chain from a foundational principle to the clinical symptom. Our phenomenological starting point is Gallagher’s Pattern Theory of Self, which describes the self as a dynamic, multi-dimensional pattern rather than a static entity (Gallagher, 2013). This provides an elegant “what,” but lacks a mechanistic “how.” We argue that this explanatory gap is filled by our subsequent levels. First, we lay the foundation (Chapter 2) by detailing Northoff’s concept of the world-brain relation. Crucially, we interpret the “brain” in this context through the lens of 4E cognition, corresponding to the German concept of *Leib*—the lived, experiencing, and enactive body-organism, thus avoiding a cartesian “brain-in-a-vat” perspective from the outset. We then describe the central mechanism (Chapter 3): Active Inference, which provides the process model for how this embodied self-pattern maintains its stability and alignment. Finally, we demonstrate the neural manifestation of this process at the macroscopic level (Chapter 4), showing how a dysregulation of this mechanism is reflected in network imbalances (Williams, 2017). The integration of these levels, particularly the extension of Active Inference by an existential dimension of meaning-making (‘Resonance’), culminates in the proposed “Resonance-Inference Model.” In the concluding discussion (Chapter 5), we explore the far-reaching implications of this model for the definition of transdiagnostic biotypes and the development of novel, dynamics-based therapies.

## The Foundation: Spatiotemporal Dynamics and the World-Brain Problem

To develop a viable mechanistic model for psychiatry, we must question our most fundamental understanding of the relationship between brain and mind. The traditional neuroscientific approach, often implicitly based on Cartesian dualism, attempts to locate mental states in specific brain regions or neural activity patterns. However, this approach, which seeks to solve the “mind-body problem,” inevitably leads to an explanatory gap: How can the immaterial quality of subjective experience arise from the firing matter of the brain? To overcome this impasse, philosopher and neuroscientist Georg Northoff proposes a radical shift in perspective: a reorientation from the “mind-body problem” to the “world-brain problem” (Northoff, 2023). This reorientation, which he terms a “Copernican turn,” shifts the focus from the intrinsic properties of the brain to the relational dynamics that unfold between the brain and the world. This chapter outlines how this relational perspective forms the foundation for a dynamic, spatiotemporal understanding of mental health and illness.

## From the “Mind-Body” to the “World-Brain” Problem

Northoff’s central thesis is that the brain cannot be understood as an isolated organ whose properties arise purely from its internal organization. Instead, its fundamental architecture and mode

of operation are profoundly shaped by the fact that it is embedded in a structured environment and has evolved to align with this environment. The brain is thus an intrinsically relational and neuro-ecological organ. The crucial question is no longer how the mind emerges from the brain, but how the brain relates to the world in such a way that consciousness and self-awareness become possible in the first place.

This shift has profound implications. It means that we no longer view mental phenomena as properties “contained” within the brain, but as the result of the dynamic coupling or alignment between neural and environmental processes. The brain is not a passive receiver of information waiting for stimuli. On the contrary, it is an organ with enormous intrinsic activity, consuming nearly 90% of its energy budget (Raichle, 2010). This spontaneous, highly structured activity is not random noise. Rather, it constitutes a continuous simulation or a generative predictive model of the statistical and temporal regularities of the world. The brain constantly tries to adapt its internal dynamics to the external ones and to resonate with them. A simple example is following a rhythm: the brain does not wait for the next beat to sound before anticipating it, but proactively synchronizes its own neural activity with the external tempo. This synchronization, this alignment, is the very basis of perception. We do not perceive the world by passively mapping it, but by actively predicting it and continuously updating our predictions based on sensory data.

### “Common Currency”: The Spatiotemporal Structure of Brain and World

If the alignment between brain and world is so fundamental, there must be a “common currency”—a property common to both systems that makes such a coupling possible. Northoff identifies this common currency in spatiotemporal dynamics (Northoff, 2023). Both the brain’s activity and events in the world unfold in space and time and possess an inherent dynamic structure.

On the brain’s side, this dynamic manifests in neural oscillations, the rhythmic fluctuations in the electrical activity of neuronal populations. These waves (e.g., delta, theta, alpha, beta, gamma) are not mere epiphenomena but a central organizing mechanism. They are hierarchically nested (“cross-frequency coupling”), such that slow waves, like the delta waves (<4 Hz) dominant during deep sleep, provide the global contextual frame for the activity of faster waves. Faster oscillations, like gamma waves (>30 Hz), are associated with the local processing and binding of sensory information and are embedded within the phases of slower waves. This intrinsic dynamic also exhibits features of scale-freeness, a property of complex systems where similar patterns recur at different temporal and spatial scales (“power-law distribution”). This property suggests that the brain operates in a state of “self-organized criticality”—a delicate balance between order and chaos that allows for maximum information processing capacity and flexibility (this point will be crucial in Chapter 3). This complex yet highly structured internal temporality enables the brain to map and anticipate the equally multi-scaled temporal structure of the environment.

On the world’s side, we also find a rich spatiotemporal structure. From the cycles of day and night, to the rhythms of heartbeat and breath, to the sequential structure of language and music, our environment is permeated by temporal regularities. World-brain alignment postulates that the brain uses its intrinsic dynamics to “latch on” to these external rhythms. When the frequencies and phases of neural oscillations synchronize with the temporal structure of an external event, that event is consciously perceived. Spatiotemporal dynamics are thus the bridge that closes the ontological gap between neural and mental phenomena. It is the code in which both the language of the brain and the language of the world are written.

### The Self as a Spatiotemporal Pattern

This perspective also revolutionizes our understanding of the self. Traditionally, the self is often conceived as an entity or a “CEO” in the brain. From a spatiotemporal viewpoint, however, the self is not a thing but a process or a dynamic pattern. It arises from the continuous and recurrent

alignment of the brain's dynamics with the dynamics of its own body (interoception) and the environment (exteroception) (Northoff, 2023).

The stability of our sense of self, the feeling of being the same person over time, reflects the remarkable stability of this relational pattern. The brain aligns not only with the external world but, crucially, with signals from its own body. The slow rhythms of cardiac activity and respiration form a fundamental temporal base upon which faster mental processes are built. These interoceptive signals are processed in regions like the insula and are critical for our emotional experience. The intrinsic activity of cortical midline structures, particularly the Default Mode Network (DMN), is often associated with self-referential thought (e.g., autobiographical memory, future planning). In the spatiotemporal model, the activity of the DMN does not represent the self per se, but rather the neural core of the alignment between intrinsic brain activity and external and internal contexts. The DMN integrates the past (memories) and the future (plans) into the present, thereby creating a coherent, temporally extended narrative identity. The self is thus the spatiotemporal signature of the unique way a brain is interwoven with its body and its world. It is the unique melody that emerges from the interplay of internal and external rhythms.

## From Alignment to Mal-Alignment: Spatiotemporal Signatures of Psychopathology

If mental health is a state of flexible and robust world-brain alignment, then psychopathology can be conceptualized as a state of mal-alignment. This is a fundamental disruption of the brain's ability to couple its internal dynamics to those of the environment. This decoupling can manifest in two extremes: an excessive rigidity or a chaotic fragmentation of neural dynamics.

### *Attachment and Trauma: The Genesis of (Mal-)Alignment*

This process begins in the earliest stages of life. Secure attachment can be understood as a process of mutual temporal synchronization between caregiver and infant. The rhythmic, predictable interactions (e.g., rocking, speaking, eye contact) help the infant's brain to organize its own intrinsic dynamics and to develop a fundamental trust in the temporal structure of the world (Northoff, 2023). The caregiver acts as an external regulator who "tunes" the child's neural rhythms. Developmental trauma, on the other hand, represents a massive breach of this synchronization. Unpredictable, chaotic, or threatening environments prevent the formation of a stable alignment. The traumatized individual's brain remains in a state of desynchronization. Its intrinsic dynamics are decoupled from those of the world, which manifests in symptoms such as dissociation, hypervigilance, and a fundamental disruption of the experience of time and self. The brain's intrinsic neural timescales are pathologically altered: in a state of hypervigilance, they are chronically shortened, with the brain operating in a mode of constant, immediate threat anticipation. In dissociative states, they may lengthen, leading to a feeling of alienation from the present.

### *Temporal Rigidity and Fragmentation: Signatures of Mental Disorders*

This idea of mal-alignment can be applied to specific disorders. In depression, a form of temporal rigidity is observed. The neural dynamics lose their flexibility and complexity, falling into a rigid, repetitive attractor state that manifests phenomenologically in rumination and anhedonia. Depressed patients often describe a feeling that "time has stood still" or that they are "stuck in the past." This is the subjective expression of a brain whose internal time has become disconnected from the external world and is trapped in a slow, low-entropy loop. Empirical studies support this, showing reduced variability and complexity in EEG and fMRI signals in depressed patients. In contrast, schizophrenia or psychosis can be understood as a state of temporal fragmentation and chaotic disintegration of brain dynamics. The ability to synchronize and maintain a coherent alignment is fundamentally disturbed. This manifests in a disrupted hierarchical coupling of fast and slow neural oscillations. Without the organizing framework of slow waves, the processing of local sensory stimuli becomes

contextless and chaotic. This leads to a dissolution of the boundaries between self and world, a disorganization of thought and perception, and a collapse of the shared temporal framework that constitutes our reality. The brain is no longer able to establish a stable relationship with the spatiotemporal structure of the world, resulting in a profoundly fragmented experience.

## The Mechanism: Active Inference, Synergetics, and the Criticality of Consciousness

If world-brain alignment describes the fundamental “what” of mental life, the crucial question of “how” remains: What neuro-computational mechanism enables, controls, and maintains this dynamic alignment? This chapter argues that the framework of Active Inference, developed by Karl Friston and colleagues, provides a formally precise and biologically plausible answer. It translates the philosophical conception of the brain as an ecological organ into the language of information theory, describing it as a prediction machine that relentlessly strives to minimize its surprise about sensory inputs.

However, the full explanatory power of this predictive mechanism is only unlocked by integrating two further theoretical levels: synergetics, which as the science of self-organization describes the dynamics of change, and the concept of a hierarchically supreme “Master Prior.” Synergetics provides the language to understand mental states as stable “attractors” and to conceptualize change as an abrupt “phase transition” (Haken, 1996). The “Master Prior,” inspired by Viktor Frankl’s logotherapy, is introduced as the highest control level of the generative model—a fundamental belief in the meaningfulness of existence that stabilizes the system even in chaotic transition phases (Leidig, 2025c).

This inference process is inextricably linked with affect and is governed by two fundamental, antagonistic control systems—a future-oriented, excitatory (E) and a past-oriented, inhibitory (I) system (Tucker, Luu, & Friston, 2025). The dynamic balance of these systems is crucial for keeping the brain in an optimal state of criticality—a narrow ridge between order and chaos that corresponds to mental health. Pathology, therefore, arises when this balance is broken and the system drifts into stable but maladaptive, rigid (sub-critical) or chaotic (super-critical) attractor states, creating the basis for a mechanistic reinterpretation of psychiatric disorders.

## The Predictive Brain: The Free Energy Principle and Active Inference

The Free Energy Principle (FEP) is a fundamental theory postulating that any self-sustaining system must strive to minimize the unpredictability of its interactions with the environment to ensure its existence (Friston, 2010). A living being must avoid surprise (in information-theoretic terms, “surprisal”). Since an organism cannot directly measure “surprise,” it instead minimizes a proxy value: variational free energy. This is essentially the discrepancy between what the brain believes it knows about the world (its generative model) and what its senses tell it. Minimizing free energy is thus synonymous with minimizing prediction errors.

Active Inference describes how this happens:

- *Perceptual Inference (Perception)*: The brain adjusts its internal models (“beliefs”) to better explain the sensory data.
- *Active Inference (Action)*: The brain changes the world to make it better fit its predictions.

Perception and action are thus two sides of the same coin. The “world-brain alignment” finds its precise, mechanistic counterpart here.

## An Affective Machine: The Dual Control Systems of Elation (E) and Inhibition (I)

Affects are the central control elements of this process. Tucker, Luu, and Friston (2025) identify two antagonistic control systems that modulate the precision (the confidence in prediction errors):

- *The Excitatory (E) Control System*: Future-oriented, geared towards action, and neurobiologically linked to the dopaminergic system. The associated affect is “elation”.
- *The Inhibitory (I) Control System*: Past-oriented, geared towards model adjustment, and associated with the serotonergic system as well as areas like the ACC and insula. The associated affect is “inhibition” (anxiety).

Mental health depends on the dynamic balance of these two systems.

### Criticality, Neuromodulation, and the Stabilizing “Master Prior”

The state of a healthy E/I balance corresponds to a state of criticality—a delicate equilibrium between order (sub-critical) and chaos (super-critical) that enables maximum information processing (Tucker, Luu, & Friston, 2025). This state is actively maintained through neuromodulation.

However, this neuromodulatory fine-tuning is itself controlled by the highest hierarchical level of the generative model: a supreme prior or “Master Prior.” This concept describes a fundamental, often unconscious belief about the basic nature of reality and the meaningfulness of one’s own existence (Leidig, 2025b). This control potential, however, does not necessarily unfold on its own; it often requires an openness to this existential dimension, which can be experienced through formative life events or in resonance with other people. It is important to note that this is not a rigid top-down regulation. Rather, this ‘Master Prior’ operates in the sense of circular causality: While it fundamentally shapes processing on all lower levels as the highest ordering parameter, it is itself continuously questioned, confirmed, or ideally, flexibly modified by ascending prediction errors—that is, by the sum of our lived experiences. It is thus both the origin of predictions and the ultimate target of their correction. This “spiritual prior” is not necessarily religious but can manifest in beliefs such as “I am part of a greater whole” or “Life has meaning, even in suffering.” This Master Prior acts as the ultimate control parameter that, via downward causation, regulates the precision weighting on all lower levels and thus the global E/I balance and the criticality of the system (Leidig, 2025c). A stable, positive Master Prior (e.g., “I trust the process of life”) acts as an anchor, allowing the system to tolerate even major prediction errors (strokes of fate) without collapsing into a pathological state.

From this perspective, psychopathology is a disruption of this hierarchical and circular causality. A “broken” or negative Master Prior (e.g., “The world is a fundamentally hostile place”) leads to chronic dysregulation of neuromodulation and pushes the system into a stable but maladaptive attractor state:

**Sub-critical Dynamics (Depression):** A negative Master Prior (“Everything is meaningless”) leads to a dominance of the I-system. Synergetics describes this state as a deep, rigid attractor (Haken, 1996). The system is trapped in a state of low entropy, unable to explore new states. The resulting slow, rigid spatiotemporal dynamics, in turn, reinforce the neuromodulatory dysfunction that confirms the negative prior.

**Super-critical Dynamics (Psychosis):** A fragmented or contradictory Master Prior could lead to a dominance of the E-system. From a synergetic viewpoint, this corresponds to a chaotic, unstable dynamic without a clear attractor. The system relentlessly generates new hypotheses to explain the perceived incoherence, further fueling the fragmented spatiotemporal dynamics.

### The Central Role of Sleep and the Therapeutic Phase Transition

The nightly calibration of the E/I balance occurs during sleep (Tucker, Luu, & Friston, 2025), which resets the system to criticality for the next day. However, if the system is trapped in a deep, maladaptive attractor, sleep alone is no longer sufficient. Profound change requires a “phase transition”—an abrupt, non-linear leap to a new state (Leidig, 2025a). This is often triggered by a “sacred prediction error”: an experience so radically at odds with the deepest negative priors that the system is pushed into a state of maximum free energy and creative chaos. To survive this potentially disintegrating state, the activation of a new, positive Master Prior is crucial. It provides the necessary

anchor that allows the organism to tolerate the chaotic transitional phase and reorganize into a new, healthier, and more coherent attractor.

## The Manifestation: Large-Scale Networks and Clinical Biotypes

The preceding chapters have laid out the foundation (World-Brain Alignment) and the mechanism (Active Inference and Criticality) of our model. But how do these abstract principles manifest at the level of observable brain organization? This chapter bridges the gap to clinical neurobiology by showing how the dysregulation of the E/I balance and spatiotemporal dynamics becomes visible in the patterns of large-scale brain networks. We rely heavily on the “Triple-Network Model,” which has proven to be a robust framework for understanding transdiagnostic pathologies (Williams, 2017). We will then integrate these levels to develop a multi-scale view of psychopathology. Finally, we argue that this approach paves the way for a new generation of “spatiotemporal biotypes” that go beyond static biomarkers and capture the dynamic nature of mental disorders.

## The Macroscopic Signature: The Triple-Network Model

The study of intrinsic brain activity using resting-state fMRI has shown that the brain is organized into coherent, functional networks. Three of these networks are of particular importance for psychopathology and are often summarized as the “Triple-Network Model”:

- *The Default Mode Network (DMN)*: This network, whose core regions include the medial prefrontal cortex (mPFC), posterior cingulate cortex (PCC), and precuneus, is most active when we are at rest and our mind is wandering. It is central to self-referential thought processes, autobiographical memory, thinking about the future, and theory of mind (the ability to attribute mental states to others). Overactivity of the DMN is stereotypically associated with rumination and negative self-referential thoughts (Williams, 2017).
- *The Salience Network (SN)*: The SN, with its key nodes in the anterior insula (AI) and the dorsal anterior cingulate cortex (dACC), acts as a detector and filter. It identifies the most relevant internal (e.g., bodily signals) and external stimuli that require our attention. Functionally, the SN acts as a dynamic switch, modulating activity between the introspective DMN and the task-oriented Central Executive Network to enable an appropriate response to salient events.
- *The Central Executive Network (CEN)*: This network, whose main components are the dorsolateral prefrontal cortex (dlPFC) and the posterior parietal cortex (PPC), is the basis for higher cognitive functions. It is crucial for working memory, action planning, problem-solving, and maintaining attention on goal-directed tasks.

Mental health is characterized by a flexible and dynamic balance between these three networks. In particular, the anti-correlation between the DMN and CEN is a sign of healthy brain function: when we focus on an external task (CEN active), the self-referential activity of the DMN is down-regulated. A disruption of this balance is a transdiagnostic marker for psychopathology (Williams, 2017).

## Integrating Dynamics, Mechanism, and Networks

The true explanatory power of our model lies in the synthesis of the three described levels. The dysfunction in the triple-network model is not the cause of the pathology but the visible manifestation of the underlying disruption of the E/I balance and spatiotemporal dynamics.

The Salience Network can be understood as the macroscopic implementation of the precision-weighting mechanism of Active Inference. It is the SN's job to detect prediction errors with high precision (i.e., “salient” events) and to allocate the corresponding neural resources—either by activating the CEN for problem-solving in the external world (action) or by activating the DMN for reflection and model updating (perception).

- Depression (Sub-critical state,  $I > E$ ):
  - Mechanism & Dynamics: The dominance of the I-system leads to a sub-critical, rigid, and temporally slowed dynamic. Negative beliefs (priors) are endowed with pathologically high precision.
  - Network Manifestation: This translates directly into the network pattern described by Williams (2017). The SN is hyperactive and fixated on internal, negative signals (interoceptive prediction errors). Instead of switching flexibly, it permanently directs attention to the equally hyperactive DMN. The result is a trapped state in which negative rumination (DMN) is sustained by the constant assignment of salience (SN), while the capacity for goal-directed action (CEN) is suppressed. The anti-correlation between the DMN and CEN breaks down.
- Psychosis (Super-critical state,  $E > I$ ):
  - Mechanism & Dynamics: The dominance of the E-system and the low precision of sensory data lead to a super-critical, chaotic, and temporally fragmented dynamic.
  - Network Manifestation: The SN loses its ability to distinguish between relevant and irrelevant stimuli (“aberrant salience”). Any random stimulus can be misinterpreted as highly significant. This leads to an unstable and disorganized interaction between the networks. The DMN, the generator of internal hypotheses, is no longer adequately shielded from the CEN, which explains the intrusion of self-generated thoughts into the perception of the external world (hallucinations).

**Table 1.** A Multi-Scale View of Psychopathology.

Disorder	Spatiotemporal Signature (Northoff)	Mechanism (E/I Balance & Criticality)	Network Manifestation (Williams)
Depression	<b>Temporal Rigidity:</b> Slow, repetitive, low-entropy dynamics; long intrinsic timescales.	<b>Sub-critical (<math>I &gt; E</math>):</b> Inhibitory dominance; rigid negative priors; system trapped in a deep attractor.	<b>SN-DMN Coupling:</b> Hyperactive SN couples to DMN (rumination); CEN is suppressed.
Psychosis	<b>Temporal Fragmentation:</b> Disorganized, chaotic, high-entropy dynamics; short intrinsic timescales.	<b>Super-critical (<math>E &gt; I</math>):</b> Excitatory dominance; low sensory precision; system lacks stable attractor.	<b>Aberrant Salience (SN):</b> SN assigns high salience to noise; unstable network activity.

## Towards Spatiotemporal Biotypes

The integration of these levels allows us to rethink the idea of biotypes in psychiatry. The current focus on static biomarkers, such as network connectivity at a single point in time, falls short as it ignores the dynamic nature of mental disorders. We propose instead the development of spatiotemporal biotypes or “dynamotypes,” based on the quantitative assessment of the underlying dynamics. Instead of sorting patients into categorical boxes, we could locate them in a multi-dimensional dynamic state space. The axes of this space would not be symptoms, but measurable parameters of brain dynamics, such as:

- The E/I Balance: This could be approximated through a combination of neurochemical markers (e.g., dopamine/serotonin transporter density via PET), behavioral paradigms (e.g., reinforcement learning vs. reversal learning), and electrophysiological indices.

- **Criticality:** The brain's proximity to the critical point can be estimated directly from EEG or MEG data by analyzing the size distribution of "neuronal avalanches" (the exponent of the power-law distribution is a measure of criticality).
- **Intrinsic Neural Timescales:** The characteristic time over which the brain integrates information can also be calculated from the autocorrelation of neural signals. This would make Northoff's idea of "temporal rigidity" (long timescales) vs. "fragmentation" (short timescales) directly measurable.
- **Network Flexibility:** Instead of just measuring static connectivity, we could analyze how quickly and efficiently a person can switch between DMN- and CEN-dominated states when a task requires it.

Such an approach would explain the heterogeneity within diagnoses (e.g., different depressed patients could occupy different locations in the sub-critical region of the state space) and shed light on high comorbidity (anxiety and depression might exist as adjacent "attractor valleys" in this landscape). By understanding the manifestation of network dysfunctions as the end point of a chain that begins with the fundamental brain-world relationship and is mediated by neuro-computational mechanisms, we not only create a more coherent understanding of psychiatry but also define precise, measurable, and mechanistically grounded targets for future personalized therapies.

## Discussion

The Resonance-Inference Model (RIM) outlined in this article provides a synthesis that bridges phenomenology, computational neuroscience, and systems theory. Its central proposition is to mechanize Gallagher's descriptive Pattern Theory of Self (Gallagher, 2013) using the process theory of Active Inference. The RIM posits that Gallagher's dynamic, multi-dimensional self-pattern is the generative model of the organism. This self-pattern is not abstract but fundamentally embodied (as *Leib*), maintaining its stability through the minimization of free energy. By further integrating synergetics (Haken) and affect logic (Ciompi), the RIM offers a framework that explains not only the maintenance of this embodied self-pattern but also its transformation. This concluding discussion summarizes the central conceptual shift, highlights the concrete therapeutic implications, and outlines the limitations and future research directions that arise from this expanded approach.

## A New Grammar for Psychiatry: From Static Lesions to Dynamic Mal-Alignments

The most fundamental contribution of the framework presented here is the departure from the language of static lesions and chemical imbalances to a language of dynamic processes. Psychopathology is no longer defined as "something one has" (a defective brain region, a lack of serotonin) but as "something one does" – more precisely, as a persistent, maladaptive pattern of interaction between the brain, body, and world. The core of pathology is mal-alignment: the failure of the brain to flexibly couple its intrinsic spatiotemporal dynamics with those of the environment. This shift in perspective has several key advantages. First, it overcomes the explanatory gap between different levels of analysis by postulating a "common currency" in spatiotemporal dynamics. Second, it resolves the heterogeneity problem by replacing categorical diagnoses with a dimensional location in a dynamic state space. Depression and psychosis are not monolithic entities but broad "valleys" or attractor landscapes characterized by sub- and super-critical dynamics, respectively. Third, it makes the role of time explicit, placing processes such as development, learning, and circadian rhythms (especially sleep) at the center of pathophysiology.

## Implications for an Existential-Neurodynamic Therapy

If mental disorders are dynamic disturbances of alignment, trapped in stable but maladaptive attractors, then the therapeutic path describes the logical inversion of pathogenesis: from manifest network dysfunction back to a healthy world-brain alignment. Interventions must therefore aim to alter the system's dynamics to enable this transition. The language of synergetics allows this goal to

be formulated precisely: the aim is no longer to “repair” a single defective part, but to adjust the parameters of the overall system so that it can escape its maladaptive attractor and return to a healthy, critical state (Haken, 1996).

### *Reinterpreting Existing Treatments as “Control Parameters”*

The model presented here offers a new framework for understanding the mechanisms of action of established therapies. They can all be understood as “control parameters” that reduce the stability of the pathological attractor and increase the probability of a phase transition to a healthier state.

**Table 2.** Therapeutic Interventions as Control Parameters in the Spatiotemporal Framework.

<b>Intervention</b>	<b>Primary Target (Control Parameter)</b>	<b>Postulated Effect on System Dynamics</b>
<b>Psychopharmacology</b> (e.g., SSRIs)	Neuromodulation; precision of negative priors; I-system modulation.	Flattens attractor, reduces state stability, increases entropy for exploration.
<b>Neurostimulation</b> (e.g., rTMS)	Direct network perturbation (e.g., CEN stimulation).	Pushes system from attractor, disrupts rigid coupling, adds energy for phase transition.
<b>Psychotherapy</b> (e.g., CBT)	High-precision prediction error generation; maladaptive prior updating.	Destabilizes attractor with bottom-up evidence; modifies landscape via learning.
<b>Existential Therapy</b>	Reorganization of highest-level prior (“Master Prior,” e.g., finding meaning).	Stabilizes system during phase transitions; guides self-organization to healthier attractor.

- *Psychopharmacology*: SSRIs “flatten the valley” of the depressive attractor by dampening the pathologically high precision of negative priors, allowing the system to break out of rumination with less “energy.” This does not mean that the “bottom” of the valley is raised, but that its “slopes” become less steep, making escape from the ruminative cycle energetically more probable. The goal is not to replenish a supposed “serotonin deficit,” but to change the information-theoretic landscape. The medication creates the neurochemical possibility for new learning by making the system more receptive to contradictory evidence that was previously ignored due to overpowering negative priors.
- *Neurostimulation*: Techniques like rTMS act as a targeted “push” to knock the system out of its stable state and increase the likelihood of a phase transition. It is a direct physical intervention in the brain’s spatiotemporal dynamics. For example, high-frequency stimulation of the left dorsolateral prefrontal cortex (dlPFC), a key node of the CEN, in depression aims to artificially increase neural activity in this area. This weakens the dominance of the hyperactive DMN, disrupts the rigid network anti-correlation, and provides the system with the necessary energy to overcome the “walls” of the attractor valley.
- *Psychotherapy (Local Optimization)*: Traditional psychotherapy, through targeted exposure or cognitive restructuring, generates “prediction errors” that destabilize the maladaptive attractor. These interventions aim for the “local optimization” of the generative model. In exposure therapy, for instance, the patient generates a high-precision prediction of a catastrophe (“If I

touch the spider, I will die of panic"). The actual sensory evidence ("I touched the spider and I am still alive") creates a massive, high-precision prediction error. This error forces the system to update its old, maladaptive beliefs ("priors"). Each successful trial effectively "chisels away" a piece of the attractor valley's wall, making it shallower and the exit more likely.

### *New Therapeutic Goals: Processes, Phase Transitions, and the Global Reorganization of the Self*

However, sustainable healing often requires more than a local disruption of the attractor. It requires a global reorganization of the entire self-pattern. For this, an extension of Gallagher's Self-Pattern Theory is proposed, incorporating a spiritual dimension that functions as the hierarchically highest "Master Prior" (Leidig, 2025b). The therapeutic work on this pattern follows a two-step logic that resolves the historical debate between Viktor Frankl and Alfred Längle (Leidig, 2025d).

- *The "Sacred Prediction Error" and the Phase Transition:* Profound change is often triggered by an existential crisis or an experience so radical that it breaks with the deepest negative beliefs and can no longer be ignored. This is not an ordinary prediction error that merely corrects an assumption about the world ("I thought the door was open, but it's locked"). Rather, it is what we term a "sacred prediction error." The term "sacred" is used here in a purely psychological, non-religious sense to describe the special quality and level of this moment. It is "sacred" because it touches upon the fundamental existential questions of being and shatters a core, identity-forming assumption about the self ("I thought I was fundamentally unworthy of being loved, but this person shows me unconditional affection"). Such an error does not just correct a single belief; it possesses a transformative power that touches the innermost core of the personality and forces a complete reorganization of the entire self-pattern. This "sacred prediction error" plunges the system into a creative chaos necessary for a phase transition (Leidig, 2025a). Affect logic (Ciompi, 1997) explains why this state is so aversive: it is a state of maximum emotional tension, or free energy.
- *The Two-Step Logic of Existential Healing:* To endure this chaotic state, the system needs an anchor. Herein lies the power of meaning-centered, existential therapies. They follow a two-step logic:
  1. Step 1 (Bottom-Up Foundation according to Längle): First, the fundamental experiences of existence must be addressed. Längle's four fundamental motivations (Being-able-to-be, Liking-to-live, Daring-to-be-oneself, Wanting-to-find-meaning) can be understood as basal priors. Therapies that start here (e.g., body-oriented or attachment-based approaches) aim to satisfy these fundamental needs and thus reduce the basal existential dissonance (high free energy). The goal is to create a secure "foundation of being" (Längle, 2005).
  2. Step 2 (Top-Down Orientation according to Frankl): Only on this stable foundation can work on the "Master Prior" be built. Frankl's "will to meaning" is the highest prior that gives life an overarching direction and coherence (Frankl, 1975). This is where logotherapy, narrative methods, or existential psychotherapy come in, helping the patient to develop a new, meaningful life narrative. This Master Prior stabilizes the system during the chaos and directs the self-organization toward a new, healthier attractor (Sprakties, 2023).
- *"Alignment" as a Transdiagnostic Therapeutic Goal:* The overarching goal of all forms of therapy can thus be understood as the restoration of a flexible world-brain alignment, which has both a horizontal (adaptation to the environment) and a vertical (connection to meaning) dimension.

### **Limitations and Future Directions**

It is important to emphasize that the framework presented here is primarily a theoretical synthesis. Although it is built on a broad base of empirical evidence from various fields, the

postulated causal links between the levels are, in many cases, still hypothetical. The greatest challenge for the future will be to test these hypotheses empirically.

This requires a paradigm shift in research methodology, moving away from simple group comparisons toward multi-modal, longitudinal single-case studies. We need to track the dynamics of the brain over time while simultaneously capturing different levels of analysis: electrophysiology (EEG/MEG), functional and molecular imaging (fMRI/PET), as well as behavioral and phenomenological data. The combination of these methods will make it possible to directly test the postulated circular causal relationships and to advance the development of the proposed spatiotemporal biotypes.

## Conclusions

Psychiatry needs a new language—one that does justice to the dynamic, embedded, and relational nature of the human brain. The spatiotemporal framework we have proposed is an attempt to formulate the grammar for such a language. By defining mental suffering as a “mal-alignment” between the inner time of the brain and the outer time of the world, it offers a causal bridge from the neuron to the narrative. This mal-alignment is not an abstract metaphor but the patient’s phenomenological reality. Our model makes this bridge traversable and opens up new avenues for therapies that help the brain find its rhythm again. The future of psychiatry lies in understanding its temporal choreography and its perpetual dance with the world. The path to a genuine precision psychiatry is still long, but it inevitably leads through the understanding of time.

**Disclosure of AI Assistance:** The abstract and public significance statement were generated with the assistance of the AI tool ChatGPT (OpenAI, GPT-4o, as of September 2025). All generated content was reviewed and edited by the authors, who remain solely responsible for the final version

**Conflicts of Interest:** There are no known conflicts of interest associated with this article.

## References

- American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). American Psychiatric Association.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing. <https://doi.org/10.1176/appi.books.9780890425596>
- Ciampi, L. (1997). *Die emotionalen Grundlagen des Denkens: Entwurf einer fraktalen Affektlogik* [The emotional foundations of thinking: A draft of a fractal affect logic]. Vandenhoeck & Ruprecht.
- Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine*, 11(1), 126. <https://doi.org/10.1186/1741-7015-11-126>
- Frankl, V. E. (1975). *Ärztliche Seelsorge: Grundlagen der Logotherapie und Existenzanalyse* [Medical ministry: Foundations of logotherapy and existential analysis]. Deuticke.
- Fried, E. I., & Nesse, R. M. (2015). Depression is not a unitary syndrome: Applying network analysis to understand the heterogeneity of symptoms. *Behavioral and Brain Sciences*, 38, e1. <https://doi.org/10.1016/j.jad.2014.10.010>
- Friston, K. J. (2010). The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience*, 11(2), 127–138. <https://doi.org/10.1038/nrn2787>
- Haken, H. (1996). *Principles of brain functioning: A synergetic approach to brain activity, behavior and cognition*. Springer.
- Hofmann, S. G., & Hayes, S. C. (Eds.). (2019). *Process-based CBT: The science and core clinical competencies of cognitive behavioral therapy*. New Harbinger Publications.
- Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., Sanislow, C., & Wang, P. (2010). The NIMH Research Domain Criteria (RDoC) project: Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry*, 167(7), 748–751. <https://doi.org/10.1176/appi.ajp.2010.09091379>

- Längle, A. (2005). *Sinn und Existenz: Einführung in die Existenzanalyse* [Meaning and existence: Introduction to existential analysis]. Beltz.
- Leidig, G. (2025a). The synergetics of change: Phase transitions and neural resonance in the activation of the spiritual self [Preprint]. <https://doi.org/10.20944/preprints202509.1619.v1>
- Leidig, G. (2025b). The spiritual self-pattern: A neurocognitive extension of the resonance-inference model for psychotherapy [Preprint]. [https://doi.org/10.31234/osf.io/xneq7\\_v1](https://doi.org/10.31234/osf.io/xneq7_v1)
- Leidig, G. (2025c, August 26). Vertical resonance as a control parameter: Integrating a phenomenological self-model into the criticality of active inference [Preprint]. <https://doi.org/10.20944/preprints202508.1710.v1>
- Leidig, G. (2025d). The existential neurology of meaning: A predictive processing synthesis of Längle's existential analysis and Frankl's logotherapy [Preprint]. <https://doi.org/10.20944/preprints202509.0616.v1>
- Northoff, G. (2023). *Neuropsychanalysis: A contemporary introduction*. Routledge.
- Raichle, M. E. (2010). Two views of brain function. *Trends in Cognitive Sciences*, 14(4), 180–190. <https://doi.org/10.1016/j.tics.2010.01.008>
- 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>
- Schiepek, G., & Tschacher, W. (1997). *Synergetik in der Psychologie: Selbstorganisation verstehen und gestalten* [Synergetics in psychology: Understanding and shaping self-organization]. Hogrefe.
- Seeley, W. W., Menon, V., Schatzberg, A. F., Keller, J., Glover, G. H., Kenna, H., Reiss, A. L., & Greicius, M. D. (2007). Dissociable intrinsic connectivity networks for salience processing and executive control. *Journal of Neuroscience*, 27(9), 2349–2356. <https://doi.org/10.1523/jneurosci.5587-06.2007>
- Sprakties, G. (2023). *Spiritualität als Resilienzfaktor in Lebenskrisen: Viktor Frankls Geistbegriff* [Spirituality as a resilience factor in life crises: Viktor Frankl's concept of the spirit].
- Tucker, D. M., Luu, P., & Friston, K. J. (2025). The criticality of consciousness: Excitatory-inhibitory balance and dual memory systems in active inference. *Entropy*, 27(8), 829. <https://doi.org/10.3390/e27080829>
- Williams, L. M. (2016). Precision psychiatry: A triple-network model of depression. *The Lancet Psychiatry*, 4(14);3(5), 472–480. [https://doi.org/10.1016/S2215-0366\(15\)00579-9](https://doi.org/10.1016/S2215-0366(15)00579-9)

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.