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Chapter 15

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Cracking the Brain Code to Unveil the Mystery of Consciousness

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Abstract

Robert Kozma's and Walter Freeman's book, *Cognitive Phase Transitions in the Cerebral Cortex: Enhancing the Neuron Doctrine by Modeling Neural Fields*, makes a significant contribution to the contemporary trend in neuroscience that is focusing on integrating neurophysiological and physical principles. This approach aims to illuminate how spatio-temporal patterns in brain activity emerge, enabling the brain to construct knowledge and subjective experiences from multiple information streams. Building on their extensive prior research, Freeman and Kozma propose viewing the brain's cortices as dissipative thermodynamic systems.

1. Introduction

Robert Kozma's and Walter Freeman's book, *Cognitive Phase Transitions in the Cerebral Cortex: Enhancing the Neuron Doctrine by Modeling Neural Fields*, makes a significant contribution to the contemporary trend in neuroscience that is focusing on integrating neurophysiological and physical principles. This approach aims to illuminate how spatio-temporal patterns in brain activity emerge, enabling the brain to construct knowledge and subjective experiences from multiple information streams. Building on their extensive prior research, Freeman and Kozma propose viewing the brain's cortices as dissipative thermodynamic systems. These systems, through homeostasis, sustain themselves near critical activity levels far from equilibrium, which is characterized by the expenditure of energy (reduction of entropy) to facilitate the emergence of patterns responsible for knowledge creation. The authors further posit that meanings, subjectively experienced as conscious thoughts or perceptions, can be objectively described as emergent from vast neural activity fields generated by the mass action within the nervous system, organized as metastable spatial (cinematic) frames of electromagnetic field patterns.

The pioneering work and insights of Freeman and Kozma continually inspire us in our own effort to cognize the human brain – the seat of cognition, personality, and selfhood – as an endless source of thought, creativity, and artistic expression, that are at the heart of human experience.

In this brief chapter, we first delve into the nature of the structural organization of brain electrophysiological signals, exploring their dynamics and the implications for brain and mind functions considering the Freeman's and Kozma's principles of mass action and metastable cinematic frames. In the second part, we demonstrate how these findings underpin the Operational Architectonics framework for brain-mind functioning. This framework conceptualizes mass action in the nervous system as nested, dynamic neuronal assemblies with associated local electromagnetic fields, presenting a nested cinematic dynamic of cognition that sheds light on the emergence of consciousness.

According to Operational Architectonics theory, the hierarchy of subjective world – ranging from simple phenomenological features and patterns to complex phenomenological objects and scenes – has its electrophysiological equivalent in an operational hierarchy of local electromagnetic fields. These fields are generated by transient neuronal assemblies and form nested spatial-temporal conglomerates, termed operational modules (each with distinct sizes and lifespans) that correspond to the phenomenological entities of varying complexity. The local cortical fields with their complex nested structure are best captured by the electroencephalogram (EEG) [34]. A quantitative electroencephalogram (qEEG) is a mathematically and algorithmically processed digitally recorded EEG that extracts information invisible to "naked" eye inspections of the signal [20].

2. Integrative Overview: The Structural Organization of qEEG Signals, their Dynamics, and the Implications for Brain and Mind Function

Studies examining the structural organization of qEEG signals have shown that qEEG is an extremely *non-stationary*, highly complex, and multi-layered signal [13, 15, 17, 21, 25, 28]. Contrary to popular belief, this non-stationary variability is not mere noise; rather, it mirrors the underlying neurodynamic processes, making it functionally significant, information-rich [11, 21, 27], and unique to each individual [28]. The multivariability in qEEGs is characterized by a piecewise stationary structure, where relatively stable segments with varying probability characteristics are "*glued*" together [1, 11, 13, 18, 54]. Each qEEG segment likely reflects the *oscillatory state* of an underlying transient neuronal assembly [5, 35, 43, 69, 76], indicating a *cortical functional state* that may be local (a part of the cortex) or global (entire cortex), and that can range from milliseconds (micro) to hours (macro) [31, 53, 65]. These qEEG oscillatory states, regarded as steady, transient, and self-organized *operational* units, serve as the fundamental *building blocks* of cortical activity associated with information processing, perception, and conscious thought [66, 79].

Analysis of the non-stationary behavior of *three key qEEG characteristics* – amplitude, frequency, and phase – demonstrate their abrupt changes over time. All three maintain stability around an average value before *abruptly* "jumping" to a new stable level, a transition marking a shift in brain state (for amplitude, see: [13, 18, 54]; for frequency, see: [16, 21, 27]; for phase, see: [30, 62]). These "jumps," termed ***rapid transitional periods*** **(RTPs)** [13, 18, 21], define the boundaries of relatively stable segments in the activity of brain functioning. Thus, transitions between quasi-stable qEEG segments signify shifts between brain states, ranging from micro to macro levels, as neuronal networks reorganize and interconnect [53, 54, 64]. During these shifts, the transient functional neuronal assemble undergoes changes in entropy, information content, and dimensionality [23]. Multiple microstates may exist within any single macrostate, that also may form sequences at a larger timescale. These qEEG structures thus form a *nested hierarchical system*, capturing the *poly-operational structure* of brain activity [11].

The coexistence of qEEG's high *multivariability* alongside the transient stability of these characteristics (*metastability*) has been reliably observed [21, 27]. This high multivariability in qEEG may reflect the brain's vast repertoire of states and possible configurations, while the temporal stabilization suggests persistence of neurodynamic patterns over specific intervals at both micro and macro levels. Together, this *balance between multivariability and metastability is a signature* ***(the code)*** *of the overall brain dynamics* [11, 20].

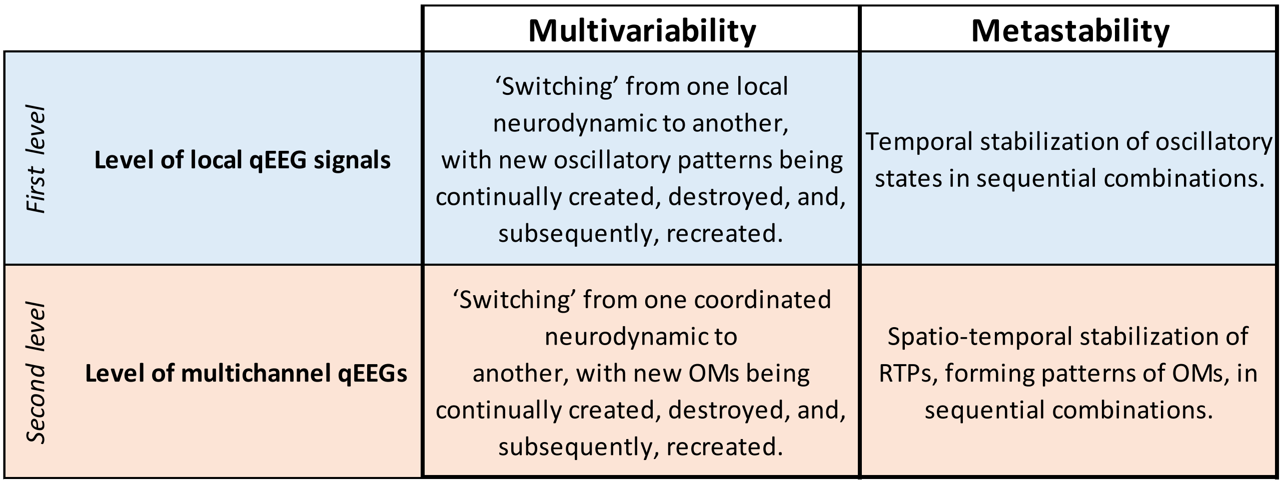
In this framework, **local qEEG signals** represent "*functional sources*" – brain regions contributing to activity recorded at a single sensor [74]. The functional source is the operational concept that defines a source that may not align with specific anatomical brain region and remain neutral regarding primary source localization or volume conduction [74].

Local EEGs are thus defined by [20]:

- The **repertoire size** of oscillatory states, indicating the diversity of qEEG segments;
- The **life-span** of each oscillatory state, reflecting the duration of neuronal assembly activity (operation);
- The **probability of occurrence** of specific oscillatory states, highlighting preferred oscillations;
- The **number of active oscillatory states**, which varies by condition, task, or function;
- The **frequency of state transitions**, indicating how often state types change;
- The **sequence of oscillatory states**, representing integral structures in qEEG organization;
- The **size of neuronal assemblies** that generate oscillatory states, estimated by qEEG amplitude;
- **Stability of neuronal assemble synchronization**, assessed by amplitude variability within qEEG segments;
- **Neuronal assemble growth or disassembly**, measured by relative amplitude patterns between adjacent qEEG segments;
- The **speed of neuronal assemble formation or disassembly**, determined by the rate of change near RTPs.

At the level of *local* qEEG signals (*fist level*), two key patterns emerge [20] (see Fig. 1):

1. **Multivariability**, marked by frequent "switching" among local neurodynamics and oscillatory patterns:
    - *Increase in*: oscillatory state repertoire, active oscillatory states, rate of change in state types, neuronal assemble disassembly, and disassembly speed;
    - *Decrease in*: oscillatory state life-span, neuronal assemble size, preferred oscillatory state probability, neuronal synchronization stability, and sequence consistency.
2. **Metastability**, characterized by *sequential* stabilization of oscillatory states:
    - *Decrease in*: oscillatory state repertoire, active oscillatory states, and rate of state-type change;
    - *Increase in*: life-span of oscillatory states, size of neuronal assemble, preferred state probability, neuronal assemble growth, assembly speed, and sequence consistency.



		Multivariability	**Metastability**
First level	**Level of local qEEG signals**	'Switching' from one local neurodynamic to another, with new oscillatory patterns being continually created, destroyed, and, subsequently, recreated.	Temporal stabilization of oscillatory states in sequential combinations.
Second level	**Level of multichannel qEEGs**	'Switching' from one coordinated neurodynamic to another, with new OMs being continually created, destroyed, and, subsequently, recreated.	Spatio-temporal stabilization of RTPs, forming patterns of OMs, in sequential combinations.

Figure 1. The first and second levels of multivariability and metastability in the local and multiple qEEG signals. Legend: qEEG – quantitative electroencephalogram; OM – operational module; RTP – rapid transitional period.

Different regions of the cortex exhibit distinct dominant qEEG oscillations [7], which form resonant communication networks across large neuron populations [3, 47]. Typically, cortical oscillators communicate only with those of matching resonance frequencies [48], disregarding non-resonant oscillators even if synaptic connections exist. This selective communication allows various oscillator assemblies to process multiple information streams without cross-interference. By adjusting burst frequencies and subthreshold oscillations, the brain controls which regions communicate at any given moment [49], providing a fast, parallel communication framework that complements the sensory network structure [7].

RTPs also play a crucial role in this communication framework. Studies on the spatial and temporal distribution of RTPs across qEEG amplitude [13, 18], phase [39, 62], and frequency [16] reveal two findings: (a) RTPs in distinct local qEEG signals systematically *coincide in time*, and (b) this *spatio-temporal synchronicity* is *non-random*, occurring at significantly higher or lower levels than expected by chance. Such RTP synchrony reflects periods of coordinated stabilization in multichannel qEEG segments, implying that various neuronal assemblies across multiple cortical regions synchronize their activities (*operations*) within specific timescales [13, 39]. This synchronization, termed "*operational synchrony*", represents the true functional connectivity of the brain (as defined by Friston et al. [44]) and was shown for qEEG amplitude, phase, and frequency, suggesting that operational synchrony as a *universal phenomenon* for different characteristics of brain electromagnetic field [20].

The stabilization pattern in inter-area cortical relationships appears as a dynamic mosaic of "operational modules" (OMs) [11, 14, 18, 23]. The lifespan of these OMs depends on the stabilization duration of the dynamic parameters among the local electromagnetic fields generated by the participating neuronal assemblies. In qEEG terms, this stabilization is reflected in the coupling of quasi-stationary segments across EEG channels, representing a metastable state [11, 13, 18, 23]. Metastability here refers to the balance between *cooperative integration* and *autonomous fragmentation* among operations (instantiated by the electromagnetic fields) of the distributed neuronal assemblies, essential to brain dynamics [56] (see also [4, 11]). This metastability reduces the brain's degrees of freedom, enabling neuronal systems to exchange critical information and reach a "consensus" suitable for functional requirements during each behavioral stage. This mutual influence among brain areas likely optimizes information processing, suggesting that effective processing relies on stable inter-cortical relationships [14, 18].

In this context, each OM represents a metastable spatial–temporal brain activity pattern, where constituent neuronal assemblies perform *independent* operations while *coordinating* with each other to execute more complex, higher-order functions [11, 13, 18, 23].

Thus, **multichannel qEEGs**, much like local oscillatory states within local qEEGs, can be characterized by [20]:

- **OM repertoire size**: the number and topographical locations of cortex areas that mutually stabilize their dynamic parameters through the RTP synchronization;
- **OM lifespan**: duration of each spatial configuration of quasi-stationary segments (coordinated neurodynamic) through the RTP synchronization;
- **Occurrence probability of OM types**: the most frequently occurring spatial configurations of synchronized RTPs;
- **Functionally active OMs count**: the types of spatial configurations of RTP synchronization that change along with changing conditions or tasks;
- **Frequency of OM type changes**: rate of changes in spatial configurations of RTP synchronization, reflecting the flexibility of neurodynamic organization;
- **OM type sequence**: consistent groupings of spatial configurations of RTP synchronization, representing longer blocks of coordinated qEEG structural organization.

This represents a *second level* of multivariability and metastability in the brain [20] (see Fig. 1), where:

1. **Multivariability** involves frequent transitions between neurodynamic states, with new OMs continually forming and dissolving. This results in:
    - *Increased* OM repertoire size, active OM count, and frequency of OM type changes;
    - *Decreased* OM lifespan, occurrence probability of specific OM types, and sequence stability.
2. **Metastability** is defined by the spatio-temporal stabilization of RTPs, forming patterns of OMs. This results in:
    - *Decreased* OM repertoire size, active OM count, and OM type change frequency;
    - *Increased* OM lifespan, occurrence probability of specific OM types, and sequence stability.

In this context, the involvement of cortical areas in a shared complex functional act (or operation) is not indicated merely by the presence of a *common qEEG rhythm* across multiple EEG channels (representing distant neuronal ensembles), but rather by the *systematic synchronization* of RTPs (rapid transitional periods) between qEEG oscillatory modes across different cortical areas. The fact that operational synchrony aligns with the cortex's morpho-functional organization, rather than being influenced by volume conduction or reference electrode placement, was proven using random RTP combinations in surrogate data. In such research, it was proven that operational synchrony is functionally sensitive to various cognitive tasks, and both healthy and pathological conditions, thus indicating that it reflects the remote, temporally coordinated operations of local neuronal assemblies (for further details, see [13, 14, 18, 54]).

It has been suggested that disrupted operational synchrony in distributed qEEG oscillations may signal dysfunction in resting-state networks during neuropsychopathology. A loss of optimal metastable balance between independent processing and integrative functions in large-scale cortical activity – possibly stemming from impairments in large-scale integrative processes or limited regional physiological variability [19] – is associated with “cognitive disintegration” [75] and “thalamocortical dysrhythmia” [73], common to many neuropsychopathologies [14, 19]. This aligns with contemporary views on brain and mind disorders, which frame disease as a disruption in the balance of autonomy (low functional connectivity) and connectedness (high functional connectivity) among brain systems that underlies healthy functioning [14, 19]. Indeed, deficits in cortical area coordination could reduce mutual constraint, leading to excessive, context-insensitive local processing. Conversely, excessive coordination may limit individual area expression, resulting in rigid, stereotyped processing. Thus, altered brain functional connectivity could contribute to the disorganization syndrome [9].

The empirical findings on the structural organization and complex dynamics of qEEG signals, reviewed above, laid the foundation for the development of the **Operational Architectonics (OA) framework for brain-mind functioning**, centered around the notion of *operation* [10, 22, 23]. Understanding of the operation as a finite process lasting in time, present in both brain and mind functioning, and considering its combinatorial nature (increasing complexity) seems especially well suited for exploring the neurodynamic mechanisms by which subjective experiences and thoughts emerge from the brain activity [22]. As we have analyzed in several publications [10, 22, 23], an “operation” formally represents a process (or series of actions/functions) applied to an operand, producing a transformation and defined within a specific timeframe (with a beginning and an end). More broadly, an operation can be seen as a state of being in effect [8]. This concept provides a foundation for examining the complexity and compositional nature of operations, where more intricate operations encompass simpler ones [23]. In other words, each operation within this nested hierarchy is not a single, uniform entity; rather, it possesses its own internal structure, with simpler operations embedded within more complex ones. Consequently, operations should not be regarded as conventional objects [77]. Instead, they are better understood as "autopoietic machines" – self-generating *processes* – or as dissipative structures [67, 68] that maintain relative stability and, in that limited sense, may be viewed as distinct "process-objects".

In the following sections, we will demonstrate how Kozma's and Freeman's fundamental concepts of "Mass Action" and "Cinematic Frames" can be interpreted within the OA framework.

3. Mass Action in the Nervous System

In 1975, Freeman originally introduced the concept of "*Mass Action*", which describes the collective synaptic interactions among cortical neurons, wherein they synchronize their potentials to generate thought processes [29]. Later, in joint work with Kozma (see section 2.2 *Temporal patterns: the carrier wave* in this book), it was expanded in relation to intelligent behavior [56, 57], and, ultimately, consciousness [63]. This coordinated neuronal activity creates a so-called "*wave packet*" [33], requiring synchronization over a shared carrier wave of outputs from numerous neurons across any given neuronal assembly. This wave packet exhibits a spatial amplitude modulation pattern, which manifests as high and low dendritic currents, establishing *local cortical fields* reflected in the EEG [34].

To relate neuronal mass dynamics from microscopic to macroscopic functional structures (through the intermediate mesoscopic level), Freeman [42] developed a *nested hierarchy* of K-sets or models [32] (Fig. 2). This hierarchy represents increasing structural and dynamic complexity in brain processes [59-61, 63]. The "K" refers to biophysicist Aharon Katzir-Katchalsky, a pioneer in studying emergent behaviors in biological systems [55]. Within this hierarchy [58, 60, 63]:

- **K0-set** describes the dynamics of a cortical micro-column (~10,000 neurons) governed by a point attractor with zero output, remaining at equilibrium unless perturbed.
- **KI-set** subsumes K0-sets from a given cortical layer, maintaining a state of non-zero background activity.
- **KII-set** integrates KI-sets from different neuronal populations (excitatory and inhibitory), enabling periodic oscillations at narrow-band frequencies.
- **KIII-set** models interactions among KII-sets across cortical regions, supporting learning and match-mismatch processing.

- **KIV-set** encompasses multiple KIII-sets across the hemisphere, supporting intentional behaviors through intermittent synchronization and desynchronization.
- **KV-set**, the highest level, models the scale-free dynamics of neocortex, supporting cognition by operating on KIV-sets.

	Multivariability	**Metastability**
Mass Action	Coordinated neuronal activity of the multiple *carrier waves* as a nested hierarchy of K-sets. In the qEEG these "wave packets" are reflected in *quasi-stationary segments*, framed by RTPs.	Temporal *stabilization* of K-sets (with increasing structural and dynamic complexity) in sequential combinations. Formation of the OMs and *operational space-time* (OST).
Cinematic Frames	Recurrent *spatial frames* of coordinated neurodynamics separated by *rapid transitions* (RTPs), with new OMs being continually created, destroyed, and, subsequently, recreated.	Spatio-temporal stabilization of RTPs, forming *metastable patterns of OMs*, their *sequential* combinations, and synchronization of several OMs at different time scales to form *higher-order* OM.

Figure 2. The relationship between multivariability/metastability and mass action/cinematic frames in the qEEG. Legend: qEEG – quantitative electroencephalogram; OM – operational module; RTP – rapid transitional period; OST – operational space-time.

3.1. Operational Architectonics (OA) Perspective on Mass Action in the Brain

Empirical evidence shows that the brain generates non-random structured spatial and temporal dynamics [22], with a wide range of frequencies [3, 6, 7] in an extracellular electric field within the brain's internal physical space-time (IPST) [22]. These dynamics are best observed using qEEG [69], which captures macro-level electrophysiological activity, reflecting operations of medium- to large-scale cortical networks and correlating well with behavior, cognition, and consciousness [22, 23, 33, 57, 69].

The OA framework examines the *temporal* structure of information flow and the *spatial* inter-area interactions within a network of dynamically transient and functional neuronal assemblies, captured in qEEG as *quasi-stationary segments* within different frequency ranges [18]. These segments represent neuronal assemblies' activity, framed by RTPs (*rapid transitional processes*) in the local qEEG signals on the millisecond scale [10, 13, 18] (Fig. 2). Indeed, qEEG waves recorded from the scalp are integrated excitatory and inhibitory post-synaptic potentials of neuronal membranes. Since they reflect extracellular currents caused by synchronized neural activity within the local brain volume [52], the qEEG signal within quasi-stationary segments is the envelope of the probability of non-random coherence (so-called a "*common mode*" or a "*wave packet*" [33]) in the neuronal masses near to the recording electrode.

Expanding on these concepts, Plikynas [70] based on Pribram and Bohm's holonomic brain theory [71] and Vitiello's dissipative quantum model of the brain [78], proposed that these *non-random wave modes* are best described by wave mechanics, such as wave/state functions or linear operators [46]. Haken uses the term "*order parameter*" [45] to describe the result of collective neuronal and synaptic interactions that generate and sustain a field, which in turn "*enslaves*" the neurons generating it.

OA theory posits that self-organizing neural fields generated by transient neuronal assemblies, are functionally isomorphic with simple phenomenal features (qualities) [22, 23]. Indeed, studies have shown that "feature-extracting" neural assemblies [6] can decompose complex stimuli into *fragments of sensations* [52, 80]. The intricate architecture of qEEG reveals the presence of an *operational space-time* (OST) residing within IPST, which is functionally isomorphic to the *phenomenal space-time* (PST) that forms the neurophysiological basis of mind's phenomenal architecture [10, 22, 23] (Fig. 2).

From the OA perspective, the emphasis is not on anatomically defined neuronal assemblies but on the nested, dynamic hierarchy of fields generated by these assemblies, that supports the complex dynamics of cognition and consciousness [12, 13, 18, 22]. For the definition of functional transient neuronal assemblies and their nested hierarchy, the reader is referred to several previously published articles that provide extensive discussion [12, 22, 23]. To a certain extent there are parallels with the work of Walter Freeman [33], György Buzsáki [6], and others (for an extensive discussion, see [12]).

4. Cinematic Model of Cognitive Dynamics

Kozma and Freeman described a *cinematic model* of cognitive dynamics in this book, likening cognitive processes to a series of movie frames (see section 3.3 *Cinematic theory of cortical phase transitions* in this book). In this model, the cortical code underlying cognition is composed of recurrent *spatial frames* of metastable amplitude modulation (AM) patterns, similar to movie frames, while *rapid transitions* between these AM patterns serve as the "shutter" [32-34] (Fig. 2). Freeman's experiments showed that these AM patterns (frames) encode the meaning of stimuli rather than merely representing them, as they adapt based on context and learning rather than remaining fixed to specific stimuli [2, 31].

The cinematic model of cognition suggests that all sensory modalities employ a *common coding principle* in the form of cinematic "sampling" of the environment [58]. Freeman observed that the synchronized activity initiating AM patterns generates a field of non-synaptic communication in the neuropil, enabling simultaneous coordination across neuronal assemblies rather than relying on serial synaptic transmission. This rapid updating mechanism allows local sensations and memories to integrate across modalities within the timeframe of each global AM pattern [38]. The self-organizing neural fields within these AM patterns align with Haken's synergetics [45] and Prigogine's concept of "dissipative structures" [72], extending attractor theory to the realm of self-organizing, far-from-equilibrium thermodynamic systems [36].

4.1. Operational Architectonics (OA) Perspective on the Cinematic Model of Cognitive Dynamics

The OA model expands cinematic model by proposing that AM patterns have a hierarchical structure. Following OA principles, it is observed that local fields (or operations) generated by transient neuronal assemblies manifest in the qEEG as quasi-stationary segments framed by sudden amplitude shifts known as rapid transitional processes (RTPs) [10, 13, 18] (also see Section 2 above). These quasi-stationary qEEG segments reflect the operations of local neuronal assemblies, each producing simple phenomenal features. When segments of activity from spatially distributed neuronal assemblies synchronize temporally, they form complex phenomenal objects or operations [22, 23]. This synchronization results in the emergence of *metastable brain states* termed Operational Modules (OMs) [10, 13, 18, 223] (Fig. 2). Metastability here reflects the simultaneous autonomy and cooperation of transient neuronal assemblies, where each assembly maintains its unique activity while, at the same time, participating in a coordinated whole [4, 11, 56, 57].

At the phenomenological level, each enduring OM is experienced as the "*phenomenal present*" of consciousness [17], embodying both the *process* and *object* of consciousness at the same time. Experimental evidence shows that OMs, generated by synchronized local fields of spatially distributed transient neuronal assemblies, can synchronize at different time scales to form *higher-order OMs* (Fig. 2), constituting even more integrated experiences [22, 23], including the complex experiential sense of Selfhood [24-26]. These complex, nested OMs are not mere supersets of simpler modules but rather cohesive *abstractions* of them [22, 23]. Each OM has a rich combinatorial complexity and a dynamic reconfiguration capacity that is essential for presenting the *fluid* and *structured* subjective experience [22, 23]. This synchronization process binds spatially dispersed phenomenal features of multimodal stimuli into unified perceptual objects or scenes, with distinct Gestalt and semantic attributes [22, 23].

In OA, the sequential, relatively stable OMs separated by rapid transitions represent the succession of phenomenal images or thoughts, contributing to the *stream of consciousness* [50]. The metastable OMs at the Operational Space-Time (OST) level effectively "*isolate*" and "*frame*" the ever-shifting, cinematic flow of conscious experience (Fig. 2). At *critical transition points* (RTPs) in mental states, an OM undergoes rapid reconfiguration: coupled local bioelectrical fields from transient neuronal assemblies in several brain areas rapidly lose functional couplings and establish new ones with other set of local bioelectrical fields generated by correspondent transient assemblies, thereby defining a new OM within the OST continuum of the brain [22, 23].

Following Freeman and Vitiello [40, 41], the scale transitions within the OA hierarchy occur through spontaneous symmetry-breaking, which can be modeled by the *dissipative quantum model* [78] or *neuropercolation* [62]. Both models address collective and nested neural behaviors near critical states from unique perspectives [58].

Based on Freeman's data [37], we suggest that nested OMs, represented as multivariate feature vectors, are linked not to microscopic sensory details, but rather to the history, context, and significance of the information for the subjects. Freeman emphasized that global spatiotemporal patterns in the brain's electromagnetic field are our best available candidates for bridging neural (physical) activity and mental (subjective) experience [37].

In summary, the book of Kozma and Freeman explores core neurophysiological principles such as "mass action", "phase space transitions", and nested "spatio-temporal metastable frames". These principles work together to form a "*brain code*" that, when fully comprehended, may aid scientists in delving deeper into the mechanisms underlying the enduring enigma of consciousness. Indeed, whenever a person engages in attention, perception, learning, memory, thought, imagination, planning, or action, the operations performed by transient functional neuronal assemblies (that are spatially distributed across distant brain regions) are selectively integrated, or "bound", into nested spatio-temporal operational modules. This process resembles a symphony, where different musical pieces come together and fade, paralleling the emergence and disappearance of phenomenological features, objects, full scenes, and even abstract ideas within the conscious mind [22].

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