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The Selfhood-Components Dynamics in the Spectrum of Discrete Normotypical and Pathological Modes

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Abstract

In this first-of-its-kind neurophenomenological study we investigated the dynamic configuration and the levels of variability of the "Self"-, "Me"-, and "I"- components that comprise a complex experiential Selfhood across 16 distinct modes covering a range of healthy-normal, altered, and pathological brain states. The phenomenology was addressed by examining the mental structures of subjective self-experience, and for the neurophysiological counterpart, we used electroencephalogram analysis to gather data on three subnets of the self-referential brain network that correspond to the three components of Selfhood. This methodological approach allowed us to uncover peculiarities and generalities in the dynamic of the Selfhood triad across a wide range of modes that could not be seen in a single study. We showed that any given Selfhood state is determined by varying proportions of "Self", "Me", and "I"-components depending on the phenomenological manifestation of a particular mode. Furthermore, we demonstrated that the "Self"-component has more leeway in expressing various pathological modes while having a very narrow window for variance in norm. The "I"-component, on the other hand, exhibits the opposite tendency, with a wide range of normal modes and only a narrow window for true pathological expression. Finally, the "Me"-component expresses a position intermediate between the "Self"- and "I"-components (though closer to the "I"-component). The findings are discussed with an emphasis on their theoretical, conceptual, philosophical, and clinical implications.

Key Words: Triad Model of Selfhood, Self-Me-I, Self-Referential Brain Network (SRN), Default-Mode Network (DMN), Subjective Sense of Self, First-Person Perspective, Electroencephalogram (EEG), Alpha Rhythm, Operational Synchrony, Functional Connectivity, Depersonalization Disorder (DD), Depression, Meditation, Depression, Post-Traumatic Stress Disorder (PTSD), Schizophrenia, Vegetative State (VS), Minimally Conscious State (MCS), Unresponsive Wakefulness Syndrome (UWS)

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"Who is the I that knows the bodily me, who has an image of myself and a sense of identity over time, who knows that I have propriate strivings?" I know all these things, and what is more, I know that I know them. But who is it who has this perspectival grasp?
Allport, 1961 (p. 128)

[I]t is an experience we cannot help but take to be of being someone, even though there is no entity causing the experience.
Gerrans, 2015 (p. 1)

Introduction

Since the earliest sparks of self-awareness in the first humans to the philosophers and scientists of today, people have attempted to understand themselves, comprehend the nature of and why Self exists. Despite this collective effort, and the fact that our conscious experience of self with related emotions and feelings is the only reality we know perspectivally, the Selfhood phenomenon is still somewhat elusive and poorly understood (Fingelkurts *et al.*, 2020). As the two epigraphs above demonstrate, the precise definition of what exactly constitutes a sense of Selfhood is difficult to achieve. Be that as it may, based on the insights of many scholars, researchers and thinkers (Gallagher, 2000; 2013; Metzinger, 2003; Zahavi, 2005; Hohwy, 2007; Damasio, 2010; Strawson, 2011; Musholt, 2015; Northoff, 2016; Millière, 2020), we have previously proposed the following definition: the "experiential Selfhood refers to a sense of the undergoing experience in its implicit first-person mode of givenness that is immediately and tacitly given as mine […] and it is accompanied by a functionally autonomous experience of subjective confidence or certitude […], making it possible to be engaged in autobiographical thoughts involving semantic and episodic memory events related to self, as well as projecting the self into the future, thus enabling the sense of invariance of a narrative self over time […]" (Fingelkurts and Fingelkurts, 2022a; p. 182; for further elaboration, see also Fingelkurts *et al.*, 2020; p. 23). This definition plausibly reflects the multilayered nature of the Selfhood phenomenon that is expressed by adopting different concepts related to self in various knowledge domains (Strawson, 2011; Musholt, 2015; Northoff, 2016). In addition, it is in line with the Gallagher's "pattern theory of self" (2013), in which self is considered as a complex *pattern* that emerges from the dynamic interactions of characteristic aspects (or qualities) that jointly make up self, although no individual aspect/component alone may be necessary or specific to constitute a self "[…] as if they are simply modifying something that has its own independent existence" (Gallagher, 2013; p. 1).

Capitalizing on this definition and related empirical evidence, the *neurophysiological three-dimensional construct model of experiential*

Selfhood was recently introduced (for an overview and empirical support, see Fingelkurts *et al.*, 2020; for further discussion, see Fingelkurts and Fingelkurts, 2011; Fingelkurts *et al.*, 2022). This triad model of Selfhood explicitly (i) reflects the self-awareness' multifaceted and multilayered nature (Snodgrass and Thompson, 1997; Musholt, 2015; Millière, 2020) and (ii) delineates the phenomenological distinctions between three key Selfhood aspects (namely *first-person agency*, *embodiment/emotion*, and *reflection/narration*), which are all commensurate with one another (Gallagher, 2013) and together constitute a coherent sense of Selfhood (Fingelkurts and Fingelkurts, 2011; Fingelkurts *et al.*, 2020, 2022).

The triad model of Selfhood

The triad model of Selfhood is built on *neurophenomenological* evidence (Fingelkurts *et al.*, 2020, 2022). Neurophenomenology was originally developed as a novel research paradigm with the intention of bringing together two distinct approaches that appeared to be incompatible (Varela, 1996): (i) the neuroscientific experimental approach (quantitative data) and (ii) the phenomenological approach (qualitative data) by combining the lived, experiential data with neuroscientific data (Olivares *et al.*, 2015), where first-person accounts and neurophysiological data mutually inform one another (Varela, 1996; Gallagher and Sørensen, 2006; Gallagher and Zahavi, 2008). Such research paradigm lays the basis for a "non-reductive neurophilosophy" (Northoff, 2016) and has already produced numerous novel results (Lutz and Thompson, 2003; Froese and Fuchs, 2012; Berkovich-Ohana *et al.*, 2020). Indeed, once the philosophies of materialism and substance dualism, which are based on outdated ideas of classical Newtonian physics, are abandoned, there are no more methodological barriers to incorporating knowledge based on first-person experiences into the sphere investigated by the scientific (hypothetico-deductive) method (Kallio-Tamminen, 2004)[2].

In terms of *neuro*physiology, the triad model of Selfhood takes into account the *three* major, spatially distinct, yet functionally interacting brain subnets — operational modules (OMs) — that collectively constitute the self-referential network (SRN) (Fingelkurts *et al.*, 2022), also known as the default mode network (Raichle *et al.*, 2001; Fingelkurts and Fingelkurts, 2011; Northoff, 2016). Each OM is made up of a set of brain regions that have tight "functional connectivity" with one another (Fingelkurts and Fingelkurts, 2011) and that can be reliably estimated by means of operational synchrony analysis of the electroencephalogram (EEG) signal (Fingelkurts and Fingelkurts, 2008, 2015). In other words, every OM is a functional

[2] When thinking about the relationship between mind and matter, consciousness and the cosmos, as well as the nature and evolutionary value of Selfhood and its constituent components, a paradigm shift related to the conception of reality askes for profound ontological, epistemological, and methodological changes.

integration of a number of local brain fields that have been registered by the EEG electrodes that correspond to them. These fields, in their turn, are the integration of even smaller local fields produced by transient functional neuronal assemblies (Fingelkurts and Fingelkurts, 2008, 2015). As a result, every OM has a distinct nested functional hierarchy in which higher levels of the hierarchy are physically composed of lower levels (Feinberg, 2000). Together, the three OMs form a higher level of functional nested architecture — the SRN (Fingelkurts and Fingelkurts, 2011; Fingelkurts *et al.*, 2020, 2022). The OMs' triad consists of one anterior OM and two symmetrical (left and right) occipito-parieto-temporal OMs (Fingelkurts *et al.*, 2020).

*Phenomeno*logicaly, the anterior OM is linked to the phenomenal first-person perspective and the phenomenal sense of agency (Fingelkurts *et al.*, 2020, 2022). It is labelled "witnessing observer" or just "*Self*" in the narrowest sense (Fingelkurts *et al.*, 2020) — as the phenomenal non-conceptual core in the act of knowing itself (Blanke and Metzinger, 2009); or, according to Velmans (2014), a sensed "centre of gravity" where one has an experience of being directly and immediately present as the focal point of a phenomenal multimodal perceptual reality (Metzinger, 2003; Revonsuo, 2006; Blanke and Metzinger, 2009). The right posterior OM is associated with the subjective experience of self as an entity that is typically localized (through interoceptive and exteroceptive sensory processing integration) within bodily boundaries — i.e., embodiment; this experience also includes related emotional states and autobiographical emotional memories (Fingelkurts *et al.*, 2020, 2022). It is labelled "representational-emotional agency" or just "*Me*" (Fingelkurts *et al.*, 2020). This component of Selfhood is conceptually equivalent to the "minimal self" of Gallagher (2000), the "proto-self" of Panksepp (2005), and the "bodily self" of Damasio (2010). The distinguishing characteristic of this "Me"-module is that, instead of a phenomenal first-person perspective, here only a purely geometrical first-person perspective is present that originates from within the body representation, thus denoting an egocentric spatiotemporal self-model (Blanke and Metzinger, 2009) where one perceives the environment from a particular spatiotemporal point. The left posterior OM is responsible for the experience of thinking about and reflecting on oneself as oneself, that includes momentary narrative thoughts and inner speech, as well as reinterpretation of episodic and semantic memory events related to self — autobiographical story telling/narration (Fingelkurts *et al.*, 2020, 2022). It is labelled "reflective agency" or just "*I*" (Fingelkurts *et al.*, 2020). This component of Selfhood is conceptually related to the "conceptual self" of Neisser (1988), the "narrative self" of Gallagher (2000), the "autonoetic self" of Gardiner (2001) and Klein (2016), and the "autobiographical self" of Damasio (2010). It is this narrative self-reflection, which relies on the human's language capability (Damasio, 2010; Gallagher, 2000; Craig, 2004), that underprints the sense of invariance of Selfhood over time (James, 1890; Metzinger, 2015). And, according to Zahavi, it is "[…] the self that forms plans, makes promises, and accepts responsibilities, the self that is defined and shaped by its values ideas, goals, convictions and decisions" (Zahavi, 2014; p. 50). These competencies are intricately associated with the notions of individual autonomy and moral personhood (Haanila, 2022; Fingelkurts and Fingelkurts, 2023).

As it was previously proposed by Gallagher (2013) and later demonstrated by Fingelkurts et al. (2020, 2022), these three components of Selfhood are not a mere list of distinct features, but rather a set of dynamically intertwined components that are coalesce into a *pattern* forming a multifaceted emergent gestalt – Selfhood. Fingelkurts and colleagues (2020) have put forth a dynamic and functional model delineating the interrelationships between the three SRN OMs and the corresponding three phenomenal components of experiential Selfhood. In accordance with this conceptualization, in a healthy neurotypical person a "[…] *full-blown complex Selfhood* emerges as a locus of experience and self-ascription with a strong first-person perspective and bodily agency, accompanied by the attentional and cognitive control at the mental level, coupled with a sense of 'knowing that one knows', and revealed through the extended autobiographical self-narrative model equipped with social, emotional and evaluational aspects of self-experience" (Fingelkurts *et al.*, 2020; p. 23). A dynamic delicate equilibrium between the expression of the "Self"-, "Me"-, and "I"-components is required for the neurotypical coherent Selfhood sense to be present during everyday wakefulness. However, because of the intrinsic complexity of the Selfhood due to varying degrees and weights of its constituent components and the continuous process of readjustment in their relational interconnectivity, the coherent sense of Selfhood can be distorted as evidenced in instances of altered states of Selfhood (Fingelkurts *et al.*, 2022) or dissociative states (Fingelkurts and Fingelkurts, 2022a). Such alterations, no matter how small, are accompanied by a distinct and nuanced "qualitative flavor" (Gallagher, 2013) that effectively differentiates various alteration states of Selfhood from one another (Fingelkurts *et al.*, 2022). This way, excess or lack of expression in any of the three Selfhood components ("Self", "Me", and "I") is an alteration or deviation from the coherent state and may potentially be related not only to altered states observed in the normal population, but also to psychopathological conditions. It is assumed here that the same triad structure of human Selfhood, albeit with varying manifestations of each constituent component, is likely to be a ubiquitous characteristic across the diverse range of human mental states (Fingelkurts *et al.*, 2022). Hence, it is reasonable to suggest that if a particular phenomenal mode of self-experience is observable, for example, in an individual diagnosed with schizophrenia, a comparable phenomenal mode could arise (though transitory) within the mind of a healthy/non-pathological individual as well. Therefore, both the normotypical and psychotic modes of the self should be accounted for by a *unified* neurophenomenological model of the experiential Selfhood.

Based on these observations, our interest here lies in tracing the dynamical variability in the configuration of the “Self”-, “Me”-, and “I”-components that constitute Selfhood along various conditions, including normal, altered, and pathological modes. Although it would be ideal, it is currently not possible to present a study that comprehensively encompasses all known modes of experiencing Selfhood, because the required knowledge has not yet been attained. Thus, the present study has focused on the subset of phenomenal modes which have undergone examination within the *unified* triad model of Selfhood (outlined above), that is simultaneously phenomenologically and empirically plausible (Fingelkurts *et al.*, 2020, 2022). As Metzinger puts it: “If we are seriously interested in a conceptually coherent and empirically plausible theory of the self-conscious mind, then it is important to test our conceptual tools at least against some examples of the enormous phenomenological richness of our target phenomenon” (Metzinger, 2004; p. 313).

Aim of the study

Therefore, the aim of the present study was to explore the dynamic configuration and the levels of variability of Self-, Me-, and I-components that comprise Selfhood across 16 distinct modes (examined in 8 previously published studies as well as 1 individual unpublished case) covering a range of healthy-normal, altered, and pathological brain conditions. These modes included: (1) the state after 4 months of meditation training (Fingelkurts *et al.*, 2016a), (2) up-regulation of three components of Selfhood (Fingelkurts *et al.*, 2020), (3) down-regulation of three components of Selfhood (Fingelkurts *et al.*, 2020), (4) the altered state of Selfhood “My thoughts stopped” (Fingelkurts *et al.*, 2022), (5) the altered state of Selfhood “Bodilessness with no location or time” (Fingelkurts *et al.*, 2022), (6) the altered state of Selfhood “I raised and felt the space around” (Fingelkurts *et al.*, 2022), (7) brief loss of consciousness (LOC) during “conscious connected breathing” (unpublished case), (8) major depressive disorder (Fingelkurts and Fingelkurts, 2017), (9) post-traumatic stress disorder (PTSD) (Fingelkurts and Fingelkurts, 2018), (10) depersonalization disorder (DD) (Fingelkurts and Fingelkurts, 2022a), (11) schizophrenia in adolescents (recalculated from Borisov *et al.*, 2005), (12) the unresponsive wakefulness syndrome/vegetative state (UWS/VS) (Fingelkurts *et al.*, 2012), (13) the minimally conscious state (MCS) (Fingelkurts *et al.*, 2012), (14) the UWS/VS that remained permanent after 6 years (Fingelkurts *et al.*, 2016b), (15) the UWS/VS that transited into MCS after 6 years (Fingelkurts *et al.*, 2016b), (16) the UWS/VS that emerged from MCS after 6 years (Fingelkurts *et al.*, 2016b).

To achieve this aim, we used the so-called aggregated analysis, where diverse studied modes were placed on the same reference frame within the same methodological and conceptual framework – neurophysiological three-dimensional construct model of experiential Selfhood (Fingelkurts *et al.*, 2020, 2022). This methodological approach provides a means to reveal complex dynamics within the "Self"-"Me"-"I" components across a multitude of diverse modes, which would be otherwise undetectable within any singular study. Furthermore, such methodological approach allows for the determination of the (i) consistency and generalizability of neurophenomenological findings in relation to Selfhood across diverse populations, settings, and conditions; or (ii) alternatively, significant variations in findings amongst specific subsets. Finally, the aggregation of data enables the reduction of bias inherent in individual studies and potentially enhances the reliability and accuracy of generalized conclusions.

Methodological Aspects

General

All original research studies included in the present analysis were undertaken with the understanding and written consent of each subject, with the approval of the appropriate local Ethics Committees or Review Boards, and in compliance with national legislations and the Code of Ethical Principles for Medical Research Involving Human Subjects of the World Medical Association (Declaration of Helsinki). The present analysis was carried out in accordance with standards established by the Review Board of BM-Science – Brain and Mind Technologies Research Centre. The use of the data for scientific studies was originally authorized by subjects in written informed consent that was approved by relevant ethics committees or Review Boards.

Readers interested in an in-depth discussion and the technical specifics of each of the included studies are advised to consult the provided above references. Here we shall briefly describe some common methodological aspects and characteristics of the computational techniques used.

EEG recording and pre-processing

For the current analysis, only the ongoing EEG activity that was recorded a quiet and dimly lit room while the subjects were in a standard resting state condition (but awake) with eyes closed was used. The other common characteristics of the EEG recordings include

(i) nine scalp EEG locations for electrode placement: F_3, F_4, F_z, T_5, T_6, P_3, P_4, O_1, O_2; (ii); 1-6 minutes duration of artifact-free[3] recording (depending on the study); (iii) 128-256 Hz sampling rate (depending on the study); (iv) monopolar montage with linked earlobes as a reference electrode; (v) 0.5–30 Hz bandpass; (vi) 50 Hz notch filter ON; (vii) electrooculogram (0.5–70 Hz bandpass); (viii) impedance below 10 kΩ; (ix) the EEG signal was bandpass-filtered (Butterworth filter of sixth order) in the alpha (7–13 Hz) frequency band; forward and backward filtering were used to eliminate phase shifts. The rationale for the alpha frequency choice is described in detail in Fingelkurts et al (2020).

Determining the triad of SRN OMs and assessing their synchrony strength

Our previous article (Fingelkurts *et al.*, 2022) serves as the primary source for the following technical description, as it concerns a standard procedure. In the current study, a set of nine brain areas that have been previously established as belonging to the SRN (Fingelkurts and Fingelkurts, 2011) was used. These areas were not selected arbitrarily to be part of the SRN. Nine areas (included in the triad model of Selfhood) naturally emerged as members of the three most stable task-independent EEG spatiotemporal patterns (OMs) with extremely high strength of operational synchrony. This finding has been replicated in two independent studies with participation of subjects from two different nationalities and two different sensory modalities (for more detail, see Fingelkurts and Fingelkurts, 2011). The nine operationally synchronized cortical areas were used to estimate the operational synchrony strength within the three SRN OMs: *anterior* OM – formed by F_3-F_z-F_4 EEG locations; *left posterior* OM – formed by T_5-P_3-O_1 EEG locations; and *right posterior* OM – formed by T_6-P_4-O_2 EEG locations (see Fig. 1 in Fingelkurts *et al.*, 2022).

Estimating the operational synchrony strength within each OM requires going through a number of hierarchical stages of data processing. This multistage procedure's specifics can be found elsewhere (Fingelkurts and Fingelkurts, 2008, 2015). Here, the main steps are only briefly summarized. During the first stage, each local EEG signal was reduced to a naturally existing temporal sequence of nearly stationary (quasi-stationary) segments of varying length. An adaptive segmentation procedure (Fingelkurts and Fingelkurts, 2008, 2015) was used to uncover these quasi-stationary segments from the complex nonstationary structure of the local EEG signals. The aim of such segmentation is to divide each local EEG signal into naturally existing quasi-stationary segments by estimating the intrinsic

[3] Visual assessment of the raw EEG data combined with a computerized artifact detection and rejection algorithm served as the primary method of artifact removal (for details, see Fingelkurts *et al.*, 2020, p.7).

boundaries between segments, known as *rapid transitional periods* (RTPs). RTP is defined as an abrupt change in the analytical amplitude of the EEG signal above a specific threshold derived from modelling studies and statistical analysis (Fingelkurts and Fingelkurts, 2008, 2015). It has been proposed that each stationary (homogeneous) segment of the local EEG signal corresponds to a temporary stable local microstate—an *operation* that is carried out by a neuronal assembly (Fingelkurts *et al.* 2010). It follows that the temporal coupling (synchronization) of such segments among various local EEG recordings reflects the synchronization of operations (i.e. *operational synchrony*) produced by various neuronal assemblies (located in multiple cortical regions) into the integrated and unified patterns responsible for complex mental or cognitive operations (Fingelkurts *et al.*, 2010).

The second stage of the analysis involves estimating the operational synchrony within each OM. Formally, operational synchrony quantifies the statistical level of RTP temporal coupling between two or more local EEG recordings (Fingelkurts and Fingelkurts, 2008, 2015). If there is no synchronization between EEG segments derived from each pair of EEG channels, this measurement tends toward zero; otherwise, it can have positive or negative values[4]. Positive values (above upper stochastic threshold) signify an “active” process of segment coupling (synchronization of EEG segments is observed significantly more frequently than expected by chance as a result of random segment shuffle during computer simulation), whereas negative values (below lower stochastic threshold) signify an “active” process of segments decoupling (synchronization of EEG segments is observed significantly less frequently than expected by chance as a result of random segment shuffle during computer simulation) (Fingelkurts and Fingelkurts, 2008, 2015). The *strength* of EEG operational synchrony is proportional to the actual (absolute) value of the measure: the higher this value, the greater the strength of functional connection and, correspondingly, the *functional integrity* of the OM. Using the described pair-wise analysis, operational synchrony was identified in several (more than two) channels – synchrocomplexes (SC); these define OMs. The criterion for defining an OM is a sequence of identical synchrocomplexes (SC) occurring during each 1-min epoch, whereas a SC is a set of EEG locations where each location forms a paired combination with valid values of operational synchrony with all other EEG locations within the same SC; meaning that all pairs of EEG locations in an SC must have statistically significant

[4] The issue of volume conduction often presents an obstacle in interpreting EEG data in terms of brain functional connectivity. The operational synchrony measure used in the current study has been specifically tested through a number of previous modelling experiments to address the issue of volume conduction (Fingelkurts and Fingelkurts, 2008, 2015). These tests demonstrate that operational synchrony values are indeed sensitive to morpho-functional organization of the cortex as opposed to volume conduction, EEG signal power, and/or choice of the reference electrode (for further details, we refer the reader to Fingelkurts and Fingelkurts, 2008, 2015).

synchrony linking them together (Fingelkurts and Fingelkurts, 2008, 2015).

Statistical Analyses

Using EEG operational synchrony analysis (described briefly in the previous subsection), the strength of functional connectivity within every of the three OMs was determined as an average value for all 1-minute EEG epochs of each subject per state and condition. These values of each OM for eyes closed resting condition[5] of healthy individuals without current or past neurologic or mental complains served as the baseline reference state against which all other modes/conditions were contrasted. The differences in OMs' operational synchrony strength between any given mode and the baseline reference were presented as *percentage points* from the baseline reference that was taken to be "0". In this context, an increase in percentage points indicates an increase in OM's operational synchrony, while a decrease in percentage points indicates a decrease in OM's operational synchrony. The levels of statistical significance were determined in the original studies (see references above in the subsection "Aim of the study").

Results and Discussion

General observation

Figure 1 presents the strength of EEG operational synchrony within each OM of the SRN triad ("Self", "Me", "I") as the change (in percentage points) from the corresponding baseline reference state across a wide spectrum of modes that include normal, altered and pathological conditions. Corresponding data are presented separately for 16 distinct modes. The rest condition with closed eyes in healthy individuals was taken as a baseline reference functional state, and it is denoted in the figure as "0". Positive changes signify an increase in OM's operational synchrony (and the corresponding phenomenological sense), while negative changes indicate a decrease.

[5] The awake resting state is typically referred to as a "baseline" of brain activity that is distinct from both sleep and any type of task involving explicit perception, memory or other cognitive activity (Fingelkurts and Fingelkurts, 2022b).

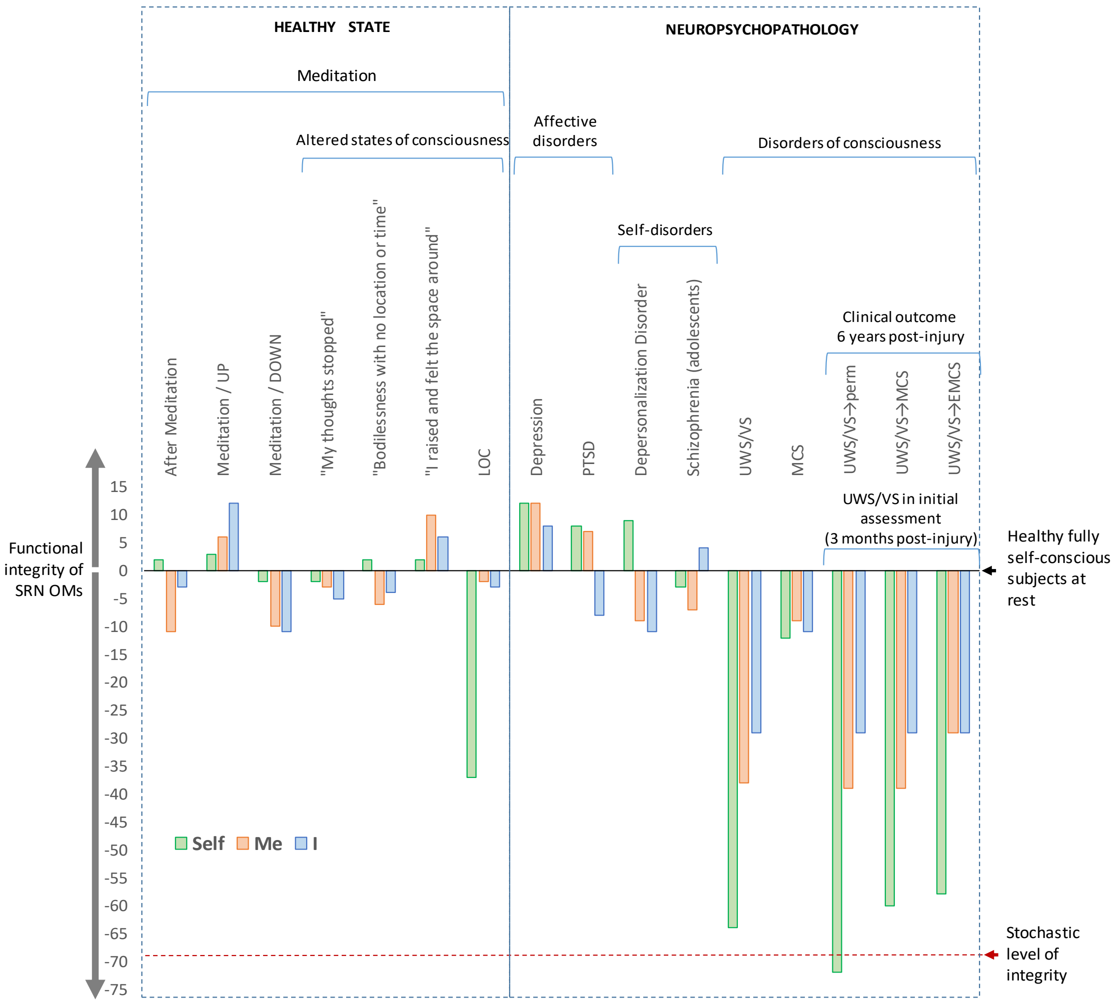

Figure 1. The change (in percentage points) from the corresponding baseline reference state across 16 modes in the strength of EEG operational synchrony within each OM of the SRN triad. The *Y*-axis presents percentage points change. The "zero" represents absence of difference from the baseline normative reference. The *X*-axis represents the three OMs corresponding to three phenomenological components of Selfhood: "Self" (witnessing agency), "Me" (body-representational agency) and "I" (reflective/narrative agency) across 16 modes. Abbreviations: SRN – self-referential network; OM – operational module; Meditation/UP – up-regulation of three components of Selfhood; Meditation/DOWN – down-regulation of three components of Selfhood; LOC – loss of consciousness; PSTD – posttraumatic stress disorder; UWS/VS – unresponsive wakefulness syndrome/vegetative state; MCS – minimally conscious state; UWS/VS→perm – permanent vegetative state (VS after 6 years post-injury); UWS/VS→MCS – transited to MCS after 6 years post-injury; UWS/VS→EMCS – emerged from a MCS after 6 years post-injury. The horizontal dotted line denotes the stochastic (random) level of functional integrity. The levels of statistical significance were determined in the original studies (see references in the subsection "Aim of the study").

As it can be seen from the Figure 1, the dynamic configurations (and degree of change) of the "Self"-, "Me"-, and "I"-components that comprise Selfhood were distinct for every given mode. Additionally, they corresponded to the associated phenomenological experiences (see below). The following is a separate brief consideration of each of the modes.

Mode: After meditation (Fingelkurts *et al.*, 2016a,c)

It is known that long-term meditation practice increases a sense of witnessing observation while also decreases bodily tensions (along with associated emotional states) and the prevalence of self-related thoughts or rumination (Brewer *et al.*, 2011; Fell, 2012; Nash and Newberg, 2013). In this study the meditation training lasted 4 months and required 20 min of daily meditation (Fingelkurts *et al.*, 2016a). The subjects were assessed before and after the four-month meditation training was completed. In comparison to a pre-meditation state, long-term meditation led to an increase in the "Self"-OM's integrity and a decrease in both "Me"- and "I"-OMs' integrity (Fig. 1). This result is entirely consistent with the anticipated phenomenological changes reported for meditation training: (i) the increase in the "Self"-OM was proposed to relate to the "samadhi" state, which has been repeatedly described as an "unbroken experience of existence attained by the still mind" in a variety of meditation techniques (Nash and Newberg, 2013); this state is characterized by a passive observer who simply witnesses events, perceptions, or thoughts in its implicit first-person mode of givenness (Fingelkurts *et al.*, 2016a); (ii) the decrease in "Me"-OM was associated with diminished experience of embodiment, bodily tensions (disturbing interoceptive and exteroceptive sensations), and ego boundaries (Fingelkurts *et al.*, 2016a); (iii) the decrease in "I"-OM was linked with diminished narrative thoughts and mind-wandering (Fingelkurts *et al.*, 2016a). Generally, the experienced long-term meditators reported persistent experience of self-agency without bodily tensions, calmness, and happiness (Fingelkurts *et al.*, 2016c).

Modes: Meditation/UP and Meditation/DOWN (Fingelkurts *et al.*, 2020)

Considering the established tight relation between alterations in the triad of SRN OMs and related three aspects/features of the phenomenal sense of Selfhood, this study was designed to explore the dynamics of functional integrity of the three OMs (that relate to three components of the sense of Selfhood) while highly-experienced meditators mentally enhanced (up-regulated) or reduced (down-regulated) each component of the Selfhood triad ("Self", "Me", and "I") on a one-at-a-time basis (Fingelkurts *et al.*, 2020). As a result, every time participants mentally and in a controlled manner willfully up-regulated the sense of "Self" (witnessing agency), "Me" (body representational-emotional agency), or "I" (reflective/narrative agency), the functional integrity of the corresponding SRN OMs increased, and conversely, willful down-regulation of the sense of "Self", "Me", or "I" resulted in a decrease of the functional integrity of the respective OMs (Fig. 1). The following subjective reports illustrate the up-regulation (Fingelkurts *et al.*, 2020; p. 11): (i) for "Self"-component: "*During the witnessing state, the whole experience was mostly unified into a field of vivid experience arising and passing* […]"; "*The mind was alert and like a wide space. It was like a consciousness outside the individual limits or like an ocean of consciousness that connects me into the world.*"; (ii) for "Me"-component: "*I was present in the body and observe simultaneously the whole body. I felt pulse of the heart, sense of tight throat when swallowing, the weight of body against the chair etc.*"; "*I was filling in the whole body with consciousness.* […] *The thoughts somehow began to be similar to the sensations of the body as if they also were part of the body, which was a centre.*"; and (iii) for "I"-component: "*The inner talk was always present.*"; "*Continuous talkative stream of thoughts related to myself.*"; "*Continuous speech-like stream of thoughts regarding mainly myself and my actions.*". Down-regulation was described as (Fingelkurts *et al.*, 2020; p. 11): (i) for "Self"-component: "*It was a state that is difficult to describe. The amount of experience seemed minor and it is difficult to say where and to whom the experience happened or did it happen at all.*"; "*In that state my life history disappeared, just a vanishing hint about something that actually did not exist. I was not thinking or observing anything.*"; (ii) for "Me"-component: "*Body or bodily feeling was widening over the body until just a soft motionless feeling without a body was left over.*"; "*My sense about the body disappeared so that I did not feel in which posture I am, do I sit or lie down. Breathing was loosening me more from my body limits.*"; and (iii) for "I"-component: "*Just noticed some fragments of thought, without a story or judging.*"; "[…] *the inner commentator was quiet and the contents of experience could freely change and flow.*"

Mode: Altered state "My thoughts stopped" (Fingelkurts *et al.*, 2022)

This altered state of Selfhood was described as: "*The thoughts stopped. A pleasant openness remained. The body was no more. Nothing to observe*" (Fingelkurts *et al.*, 2022; p. 272). Such phenomenological experience was remarkedly aligned with the neurophysiological results: it was accompanied by slight decrease in the functional integrity of the "Self"-OM, stronger decrease of the "Me"-OM and even larger decrease in the "I"-OM (Fig. 1). Generally, such changes in the configuration of the Self-Me-I triad brought about a state that is reminiscent of subjective episodes during dreamless sleep (Windt, 2015) and "is characterised by an 'emptying out' of all phenomenological contents, including thoughts, and a lack of individual first-person perspective" (Fingelkurts *et al.*, 2022; p. 273).

Mode: Altered state "Bodilessness with no location or time" (Fingelkurts *et al.*, 2022)

This altered state of Selfhood was described as: "*Bodily feeling broadened out of the body into bodilessness without location or time… Not many thoughts appeared—very few*" (Fingelkurts *et al.*, 2022; p. 266). Neurophysiologically, this phenomenological experience was characterized by a slightly enhanced functional integrity of the "Self"-OM, accompanied by decreases in the functional integrity of both "Me"- and "I"-OMs (Fig. 1). Considering the neurophenomenological data together, one may propose that during this state the "'thin/nonexplicit' experience of being an extensionless point not anchored to the body […] is sufficient for creating a phenomenological centre of gravity […] and self-identification that is tied to an individual phenomenological first-personal givenness" (Fingelkurts *et al.*, 2022; p. 266). Therefore, a slight increase of the "Self"-OM was observed.

Mode: Altered state "I raised and felt the space around" (Fingelkurts *et al.*, 2022)

This altered state of Selfhood was described as: "*I raised up with my body and felt the space around. I looked at the building from a very high place, as if from an airplane. I myself however was in my body. Autobiographical memories and thoughts were present*" (Fingelkurts *et al.*, 2022; p. 270). The neurophysiological changes in the configuration of the Self-Me-I triad were in sync with this phenomenological description: there was an increase in the functional integrity of all three OMs (Fig. 1). This observation could be interpreted as "[…] that during this [state] the participant was experiencing the so-called 'somatic' OBE, which is characterized by a changed sense of self-location in comparison to the ordinary, everyday baseline state […] without losing the sense of body, which was in fact reinforced by a constant self-reflection and analysis, and further accompanied by a slightly enhanced witnessing and self-observation" (Fingelkurts *et al.*, 2022; p. 270).

Mode: Altered state "LOC (loss of consciousness)" (unpublished case)

This brief episode of LOC spontaneously occurred during a long session of "conscious connected breathing" (CCB) (Gutfreund, 2009). The essence of CCB is the lack of pauses between inhale and exhale. Another core characteristic is that the inhale is active and typically slightly intensified, while the exhale passive, that is, completely relaxed (De Wit and Cruz, 2021). It is known that CCB may elicit altered states of Selfhood, including LOC (De Wit *et al.*, 2018). Neurophysiologically, the state of LOC was characterized by a decrease in the functional integrity of all three OMs, with "Self"-OM having the most dramatic decline (Fig. 1). In fact, the "Self"-OM's decrease was the greatest among all healthy modes (Fig. 1). We have discussed somewhere (Fingelkurts and Fingelkurts, 2023), that a loss of the functional integrity of all three brain SRN modules (“Self”, “Me”, and “I”) with profound decrease in the “Self”-OM may “[…] signify the complete absence of all self-relevant phenomenological content characterized by the ‘selfless, objectless and timeless presence’ […][6], when the self-referential mechanisms of forming the phenomenological events are suspended […]. This state is generally characterized by a marked lack of individual first-person perspective, sense of witnessing agency, and ownership […]” (p. 15). As a result, the subject was unable to describe the LOC state phenomenologically.

So far, we have discussed healthy state modes. In the sections that follow we will briefly review a number of neuropsychopathological modes with a focus on the aforementioned neurophenomenology of the Selfhood triad.

Mode: Depression (Fingelkurts and Fingelkurts, 2017)

Patients with major depressive disorder show an increased preoccupation with their own self (Northoff, 2007), constant rumination (which is a self-reflection that involves repetitively and passively focusing on symptoms of distress and on the possible self-causes and self-consequences of these symptoms; Nolen-Hoeksema *et al.*, 2008), and a high level of interoceptive awareness (Beck, 2008), accompanied by a distorted body self-image (Veale *et al.*, 2003). These phenomenological changes were associated with increased integrity of all three SRN OMs (Fig. 1), thus reflecting the well-documented excessive self-focus (“Self”-OM), rumination (“I”-OM), and embodiment (“Me”-OM) in patients with depression (Fingelkurts and Fingelkurts, 2017). Further it was documented that the strength of functional integrity within the three OMs was strongly and positively correlated with severity of depression symptoms (Fingelkurts and Fingelkurts, 2017). It has been proposed “that these three components of complex selfhood (indexed by distinct OMs of the self-referential brain network) synergize one another in a maladaptive loop and overtime become habitual, leading to a vicious circle that maintains a disordered affective state clinically manifested as depression” (Fingelkurts and Fingelkurts, 2017; p. 34).

[6] What exactly this “presence” might be is up for debate. According to Metzinger (2020) it is an inner representation of tonic alertness that goes mostly unnoticed because it functions as the transparent “model” of an abstract space in which various potential contents unfold. Similarly, we reasoned that it is the “neuronal net together with its neuropil and related complex physiology [that] constitutes an internal structural analog of 3D space—some sort of distributed coordinate matrix in the brain [that is sub-phenomenal]” (Fingelkurts and Fingelkurts, 2023; p. 6). “When it comes to phenomenology, then ‘…we never experience subjectively the contentless coordinate system as such directly; we could know about it only through the relations among phenomenal objects’ ([…]) that are ‘located’ at another (higher) level of the […] brain–mind nested hierarchy” (Fingelkurts and Fingelkurts, 2023; p. 7).

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Mode: Post-Traumatic Stress Disorder (PTSD) (Fingelkurts and Fingelkurts, 2018)

The PTSD is characterized by a number of well-established phenomenological characteristics, including: (i) the lack of the linguistic, contextual, narrative components of the autobiographical self, which prevents the traumatic event from being properly symbolized or linguistically coded/conceptualized (Ataria, 2014); (ii) the bodily encoding of the traumatic experience through enhanced sensory, motor, somatic, and emotional states that frequently recur as intrusive memories and are experienced in the "nowness" of the present (van der Kolk, 1994); (iii) the hypervigilance (or hyperarousal) and increased self-focus, which are frequently the root causes of anger, aggression, and/or self-destructive behavior of the PTSD patients (Weston, 2014). Thus, it has been proposed that "in subjects suffering from PTSD, the traumatic experience is akin to 'black hole' that engulfs into itself every aspect of the self, resulting in substantial distortion to the overall sense of selfhood" (Fingelkurts and Fingelkurts, 2018; p. 43). Neurophysiologically, the PTSD was characterized by an increased functional integrity of the "Self"- and "Me"-modules alongside a decreased functional integrity of the "I"-OM (Fig. 1), whereas the "Self"-OM was significantly associated with increased vigilance of PTSD sufferers to their surroundings and internal state, while the "Me"-OM was significantly linked to enhanced emotional, sensory, and bodily states, such as fear, stress, frozenness, shivering, shaking, trembling, palpitations, and sweating; and the "I"-OM was significantly associated with a lack of linguistic/contextual information and narrative related to a traumatic event (Fingelkurts and Fingelkurts, 2018).

Mode: Depersonalization Disorder (Fingelkurts and Fingelkurts, 2022a)

The Depersonalization Disorder is a chronic and distressing condition that phenomenologically expressed as a sense of unreality and detachment from oneself, one's own body, feelings, and autobiographical narrative; patients feel like lifeless robots, automata, the outside observers of their bodily sensations, thoughts and feelings (Sierra, 2009). This phenomenology is tightly connected with a profound reorganization in the functional integrity of three SRN OMs (Fig. 1). Decreased integrity of the "Me"-OM was associated with the anomalous body experience highlighted by a sense of disembodiment, lack of body ownership and physical agency (Fingelkurts and Fingelkurts, 2022a). Considering the "Me"-OM functions, decreased functional integrity of this module is also related to "[…] an increased sense of involuntariness [the lack of deliberate control], feeling that body sensations are not caused by oneself thus leading to detachment, where the subject stops experiencing oneself as a full-fledged embodied entity" (Fingelkurts and Fingelkurts, 2022a; p. 194-195).

Further, since “Me”-OM is linked with the perception of emotion-related bodily states, it was proposed that the very same decreased functional integrity of “Me” module was also responsible for the emotional numbness during this disorder (Fingelkurts and Fingelkurts, 2022a). Decreased functional integrity of the “I”-OM was associated with difficulties forming sequential and coherent (autobiographical) narratives signifying an alteration in self-reflection (Fingelkurts and Fingelkurts, 2022a). The upregulation of the functional integrity of the “Self”-OM was associated with an enhanced sense of “detached outside observation” of one’s own body, mental process and personal life (Fingelkurts and Fingelkurts, 2022a). It has been proposed that such hyper-observation or hyper-witnessing may be a compensation for “[…] a profound lack of intentional reflection due to a loss of narrative flow and thus incapability to make sense (‘explain away’ […]) of the experienced disembodiment and lack of ‘mineness’, leading to even stronger feeling of alienation, being an automaton, a robot-like machine” (Fingelkurts and Fingelkurts, 2022a; p. 196-197).

Mode: Schizophrenia in adolescents (recalculated from Borisov *et al.*, 2005)

The psychopathology of schizophrenia is particularly intriguing for illuminating the structure of Selfhood. In this particular mode, it was an early schizophrenia in adolescents. The typical clinical picture in these cases includes phenomenological experiences like bodily anomalies highlighted by unstable and disintegrated body image, leading to a loss of physical ownership, sense of mineness, and immediate nonreflective sense of “me” (Cermolacce *et al.*, 2007). These unsettling and unusual experiences force the subjects to compensate reflectively (thus hyper-reflectivity) for the lack of pre-givenness of mineness and agency, hence leading to a constant ongoing introspection to make sense of troubled self-hood and experience of thought pressure (Cermolacce *et al.*, 2007). At the same time, the sense of witnessing is diminished in this early stage of schizophrenia, which leads to a feeling of incomplete sense of instantaneous self-identity (that is a sense of existing as a vital and self-possessed subject of awareness; Sass and Parnas, 2003). The neurophysiological results were remarkedly aligned with this pattern of phenomenological experiences: it was accompanied by slight decrease in the functional integrity of the “Self”-OM, stronger decrease of the “Me”-OM and increase in the “I”-OM (Fig. 1). Generally, such changes in the configuration of the Self-Me-I triad brought about a state where experience is more analyzed and objectified (despite the lack of self-monitoring and executive function; Shad *et al.*, 2004) than it is spontaneously lived, resulting in anomalous and alienating experiences of early adolescence.

Modes: Unresponsive Wakefulness syndrome/Vegetative State (UWS/VS) and Minimally Conscious State (MCS) (Fingelkurts *et al.*, 2012; 2016b)

The UWS/VS (Laureys *et al.*, 2010) is defined as a “clinical condition of complete unawareness of the self and the environment” (Multi-Society Task Force on PVS, 1994; p. 1499), while MCS is “a condition of severely altered consciousness in which minimal but definite behavioral evidence of self or environmental awareness is demonstrated” (Giacino *et al.*, 2002; p. 350–351). As it is seen in Figure 1, the level of functional integrity within all three SRN OMs was drastically decreased, resulting in the lowest possible level of functionality that is already insufficient to support representational content that refers to self from the first-person perspective (Fingelkurts *et al.*, 2012). According to a previous study on the causal relationships between the triad SRN OMs and three aspects of Selfhood (Fingelkurts *et al.*, 2020), the observed profound loss of the functional integrity of the “Self”- “Me”- “I”-OMs’ triad (Fig. 1) signifies a phenomenological state of selfless, bodiless, and timeless presence that is characterized by the “emptying out” of all phenomenological contents, including thoughts, and the absence of first-person individual perspective, sense of witnessing agency, and ownership (Fingelkurts and Fingelkurts, 2023). On the other hand, “when in an MCS state, some degree of SRN functional integrity may already sustain an unstable or ‘flickering’ sense of self that is neither fully integrated nor completely fragmented (the subconscious), which is similar to dreaming […] or being in an altered state of consciousness […]. Phenomenologically, the altered states of self that patients with MCS experience include time distortion, thinking acceleration, and a variety of transcendental phenomena, such as the ‘dissolution’ of the body or an ‘out-of-body’ experience […]” (Fingelkurts and Fingelkurts, 2023; p. 14).

The last three modes depict the level of functional integrity within the three SRN OMs in patients with UWS/VS depending on the degree of self-consciousness recovery six years after a brain injury (Fig. 1). Despite the fact that very low levels of OMs’ triad functional integrity were present in all scenarios regardless of the future clinical outcome, those UWS/VS patients who recovered stable minimal or full self-consciousness later (up to six years postinjury) in the course of the disease, had stronger “Self”-OM functional integrity already at an earlier stage (three months postinjury) than those who remained to stay in the permanent UWS/VS condition, – their “Self”-OM was completely disintegrated reaching the stochastic levels (Fingelkurts *et al.*, 2016b).

The specific disorders and pathological states addressed above are not intended to be an exhaustive list, but it can be argued that many other conditions, including adult schizophrenia, Alzheimer's Disease, eating disorders, body dysmorphic disorder, anxiety disorders, and many others, could be productively interpreted and better understood within the present framework of neurophenomenology of Selfhood triad.

As demonstrated by the 16 modes that were briefly presented above, the three-dimensional construct model for the complex experiential Selfhood is not only interesting theoretically, but also useful in practice for understanding the dynamics and intertwining of three major qualities/components of self-consciousness in different states. Every mode is characterized by a *unique* configuration and degree of neurophenomenological change in the “Self”-“Me”-“I” triad (Fig. 1). To better understand the representativity of various modes in relation to a particular type of “Self”-“Me”-“I” configuration change, we arrange Table 1, which lists all possible configurations, taking only the direction of change into consideration and ignoring the magnitude of change.

Table 1. All possible* types of “Self”-“Me”-“I” configuration change.

	"Self"-"Me"-"I" configuration types							
Modes	S↑ M↑ I↑	S↑ M↑ I↓	S↑ M↓ I↓	S↑ M↓ I↑	S↓ M↓ I↑	S↓ M↑ I↑	S↓ M↑ I↓	S↓ M↓ I↓
Meditation / UP	x							
I raised and felt the space around	x							
Depression	x							
PSTD		x						
After meditation			x					
Bodilessness with no location or time			x					
Depersonalization Disorder			x					
Schizophrenia (adolescents)					x			
Meditation/ DOWN								x
My thoughts stopped								x
LOC								x
UWS/VS								x
MCS								x
UWS/VS→perm								x
UWS/VS→MCS								x
UWS/VS→EMCS								x

*Since all of the modes under study involved at least some level of change, configurations that would include “no change” are not included. Additionally, only the direction of change is considered for determining a configuration type; the magnitude of change is ignored for the purpose of this analysis. Abbreviations are the same as in the Fig. 1. Green color indicates the modes that belong to healthy conditions, while red color – the modes that belong to neuropsychopathology. The arrows on the top indicate the direction of change: light blue marks an increase, dark blue – a decrease. Grey vertical areas represent “Self”-“Me”-“I” configurations that were not associated with any of the studied modes.

One may see from Table 1 that there are many modes that are characterized by the same type of "Self"-"Me"-"I" configuration change. However, even when two or more distinct modes have the same triad configuration, the degree of expression (change) of each component will still distinguish between them (see, for example, the mode "after meditation" *vs.* the "depersonalization disorder" mode, or the mode "meditation down" *vs.* the "MCS" mode; Fig. 1). Furthermore, among the 16 studied modes, two configurations had no modes related to healthy conditions; they were only associated with pathological conditions. And, finally, three configurations were not associated with any of the studied modes.

It seems that some of the types of "Self"-"Me"-"I" configuration change appear to be more typical while others are more rear. However, given that only 16 modes were described, more research looking at a wider range of various modes is required to address the following outstanding questions: Are there any types of "Self"-"Me"-"I" configuration change that don't associate with any of the possible modes, and if so, why? Do certain types of "Self"-"Me"-"I" configuration change only occur in neuropsychopathological conditions? Are there any types of "Self"-"Me"-"I" configuration change that are exclusively associated with healthy conditions?

Figure 2. Dynamics of the change (in percentage points) from the corresponding baseline reference state across 16 modes in the OM strength of EEG operational synchrony. The modes are positioned separately for each OM from minimal to maximal values of EEG operational synchrony strength. The legend is the same as in the Figure 1.

In what follows, we will look at how the changes, when considered collectively across a wide spectrum of modes (ranging from normal, altered and pathological conditions) define the complex dynamics and variation for each component of Selfhood taken separately. For that purpose, we repositioned the 16 modes for each

Selfhood component from minimal to maximal functional integrity values of the corresponding OMs (see Fig. 2).

Intricate dynamics and variation of each Selfhood component across sixteen mental modes

Figure 2 depicts the repositioned modes from minimal to maximal values of EEG operational synchrony strength separately for each OM of the SRN triad (Self, Me, I).

Intriguingly, the "Self"-component happened to have the largest variation/variability width (84 percentage points) that was calculated by adding the highest and lowest values (taken as a module), whereas the "I"-component had the smallest – 41 percentage points (see Fig. 2). The "Me"-component occupies an intermediate position with variability width of 51 percentage points. At the same time, the "Self"-component had the narrowest "normative" range, that is the area where all studied healthy conditions fit (shown in grey in Fig. 2), while the "I"-component had the widest. The "Me"-component was once again in the middle position (Fig. 2). These findings indicate that while the "Self"-component can deviate the most from the healthy normative reference state, its normotypical variability is extremely narrow. We reasoned that most levels of deviation are incompatible with normal functioning of this component, which appears to be the most important component of the Selfhood triad (Fingelkurts *et al.*, 2020). Indeed, it has been shown that "[…] the "Self" OM (anterior subnet of the SRN) may have a central role among the three OMs in granting a critical quality for the sense of self – the phenomenal non-conceptual core in the act of knowing itself […] within the whole spectrum of human behaviours and activities […]" (Fingelkurts *et al.*, 2020; p. 23). In other words, "it is the foundation upon which our 'autobiographical', 'narrative' and 'social' selves (represented by both posterior OMs) are built" (Fingelkurts *et al.*, 2016d; p. 47). This is why, we speculate, this (relatively) narrow normative range of "Self"-component may have an evolutionary advantage. Such rigidity is carefully calibrated and highly adaptive (given the importance of functions of the "Self"-component) and seems to have reached a unique expression in humans (for more detail see footnote 20 in Fingelkurts *et al.*, 2020; p. 21).

On the contrary, the "I"-component has relatively the narrowest variability range among all three Selfhood components that nearly fully lies within the normotypical area (grey zone in Fig. 2). More specifically, the "I"-component falls within the range of potential variability of values for the majority of studied normal modes, despite being significantly different from the analogous component in the normal healthy reference state (marked as "zero" in Fig. 2). We could therefore draw the conclusion that the alteration of this Selfhood component in depression, adolescent schizophrenia, depersonalization disorder, PTSD, LOC, and MCS does not reach "true" pathological levels and is therefore not incompatible with normal functioning, thereby broadly indicating the variance of norm. It seems that self-reflection and narration, both of which are the main functions of this Selfhood component, appear also to be the most common aspects of human mental life (Damasio, 2010; Gallagher, 2000; Craig, 2004) and have evolved to have a rather broad variation range when one may have a very diverse levels of their transitory expression on a daily basis. They are often characterized by high degrees of automaticity and relative independence from the situational context (Metzinger, 2015), but at the same time they also play a distinctive role in the mental "economy" – it would be impossible to carry out many intellectual activities and deliberate actions without the capacity to be aware of one's own thoughts (Bermúdez, 2007).

As for the "Me"-component, then it largely follows the pattern of "I"-component, though with slightly smaller normative zone and slightly larger range of the expression of pathological modes (Fig. 2). The narrowing of the normative range is most likely a result of the importance of the functions supported by this component to the normal functioning of the organism as a whole[7]. These are (i) minimal embodied aspects such as core biological, ecological, and interoceptive factors that allow the organism to distinguish between itself and what is not itself (Panksepp, 2005; Blanke and Metzinger, 2009), (ii) minimal experiential aspects like first-person, pre-reflective experience, which allows the self/nonself distinction, manifest in various sensory-motor modalities (kinesthesia, proprioception, touch, vision, and so on)[8], including a sense of ownership (the "mineness" of one's experience) and agency for one's actions (Gallagher, 2000), and (iii) bodily conditioned affective aspects, such as affect and emotion (Damasio, 2010). Any changes of these functions beyond the normative range will lead to maladaptation resulted in different pathological modes (Fig. 2).

Collectively, these findings raise the issue of to what extent a particular disorder of self is "normal", in the sense that it is still a simple reversible oscillation of a state of equilibrium, and to what extent it is truly "pathological", in the sense that it induces a chronic/permanent condition[9]. Generally, the broader the dynamic range, the higher the probability of state/condition-related changes.

[7] According to a growing consensus, "embodied" living beings are fundamentally evolved to maintain their biological self-integrity and self-preservation despite functioning in extremely unstable (and sometimes hostile) social and physical environments (Ciaunica *et al.*, 2021).

[8] It has been argued that even infants are pre-reflectively aware ("Me"-component) of themselves before they develop full-fledged reflective self-consciousness (supported by the "I"-component), not as objects of other people's awareness but as co-subjects of a co-attended experience (Ciaunica and Crucianelli, 2019).

[9] This is consistent with a dimensional and transdiagnostic understanding of neuropsychopathology, whereas different components of the integral pattern that characterizes a particular condition manifest themselves in varying degrees across the entire continuum of functioning, from health to pathology (for a relevant discussion, see Fingelkurts and Fingelkurts, 2022b).

This is crucial because it gives the potential of representing the greater multivariability of various neurophenomenological states. Taken together, our findings indicate that the “Self”-component has more room to express various pathological modes while having a very narrow window for variance in norm. The “I”-component, on the other hand, exhibits the opposite tendency, with a wide range of normal modes and only a narrow window for true pathological expression. Finally, the “Me”-component expresses a position intermediate between the “Self”- and “I”-components (though closer to the “I”-component).

Another interesting observation from Figure 2 is that the maximum decrease for all components of the Selfhood triad (-72 percentage points for “Self”, -39 percentage points for “Me”, and -29 percentage points for “I”) was greater than the maximum increase (only +12 percentage points for all components). Furthermore, the decrease was observed in many more studied modes than the increase: for the “Self”-component, the decrease was observed in 56.3% of modes, while the increase was observed in 43.7%; for the “Me- and “I”-components, the decrease was observed in 75% of modes, while the increase was observed in 25%. These findings are peculiar and warrant further investigation; however, some hints may already be established. One plausible explanation could be made based on the fact that decrease in self-consciousness till its unconscious levels, does not preclude the organism from functioning, including executing complex behavior (Hassin, 2013). Indeed, it is well established that even though unconsciousness “lacks phenomenal awareness at any given time and therefore is not accessible for voluntary control (it cannot be inhibited, suspended, or terminated […]) or for rational expression (subjectivity without awareness […]), […] it can have an impact on various aspects of phenomenal consciousness, including motivation, feelings, goals, behavior, and decision making […]. Because it shares sophisticated characteristics with its conscious counterpart […], it determines significant portions of our personality, skills, preferences, and experience, and it is responsible for important aspects of our ability to adjust and function effectively […]. At the same time, it is not always integrated with the knowledge and beliefs that are held consciously, and it may even sometimes be inconsistent with them, resulting in severe conflicts and occasionally leading to mental health issues […]” (Fingelkurts and Fingelkurts, 2023; p. 4). Further, even when self-consciousness is fully disintegrated, purely neurophysiological brain processes will still continue to support information acquisition, processing, storing, and retrieval “to secure the organism own wellbeing and survival” (Fingelkurts and Fingelkurts, 2023; p. 3) and are therefore not prohibited by evolution selection. One example is the predictive-processing mechanism, which involves an interaction between top-down and bottom-up processing in the brain and the development of a generative internal model that assists the cortex in accepting or canceling out various signals by generating a statistical hypothesis about their occurrence (Seth, 2015).

On the contrary, a considerable increase in the Selfhood components is likely to be more detrimental to the organism's overall survival. For instance, Figure 2 shows that a relatively strong increase that exceeds the healthy zone (for two components) was observed for a depression mode. In this particular case, however, the depression was rather moderate (Fingelkurts and Fingelkurts, 2017). We reasoned that in cases of severe depression, such an increase may reach much higher levels, resulting in well-documented cases of severe self-harm and suicide (Orsolini *et al.*, 2020) as a way of escaping the unbearably distressing experience of self-awareness and the desire to no longer be self-aware (Baumeister, 1990). We further speculate that in order to prevent such events, some kind of "firewall" mechanism has evolved that precludes extremely high levels of Selfhood triad expression from being easily attained[10].

Finally, we have observed (see Fig. 2) that among all studied neurophenomenal modes, the largest decrease in all three OMs integrity was reached in a uniquely vulnerable and incapacitated population of patients with UWS/VS. Furthermore, only the "Self"-OM reached the stochastic levels in such patients, thus indicating its full functional disintegration (Fig. 2). As we have discussed somewhere, a profound loss of the functional integrity of all three brain SRN modules ("Self", "Me", and "I") signifies "[…] the complete absence of all self-relevant phenomenological content characterized by the 'selfless, objectless and timeless presence' […], when the self-referential mechanisms of forming the phenomenological events are suspended […]. This state is generally characterized by a marked lack of individual first-person perspective, sense of witnessing agency, and ownership […]. Additionally, subjective time (a sense of presence, past, or future) does not present anymore […]" (Fingelkurts and Fingelkurts, 2023; p. 15).

The next strongest decrease in the functional integrity of "Self"-OM was observed in the LOC mode (Fig. 2). Taken together, the findings from the LOC and UWS/VS modes suggest that a "true" unconscious state is always characterized by the absence of the witnessing agent (expressed through the "Self"-component) to whom the experience would otherwise occur and be integrated within the first-person meaningful perspective (Fingelkurts and Fingelkurts, 2023). And this is so regardless of whether the other two Selfhood

[10] To avoid any misunderstanding, we would like to emphasize that this does not imply that such an increase is not possible in some mental modes (not examined here). We hypothesize that it could be safely attained through contemplative training or breathing techniques, leading to mystic experiences and higher states of consciousness, for example. It might be analogous to the curved path to enlightenment described in some meditation traditions, where one has to pass a dysfunctional pattern of Selfhood before arriving at self-transcendence with a more wholesome self-insight (for a related discussion, see Lindström *et al.*, 2023). However, this must be demonstrated in future research.

components ("Me" and "I") are operating within the normal functioning zone (grey area in Fig. 2).

Conclusions, limitations, significance, and future research

The present study, despite being limited to a finite set of neurophenomenological modes covering a range of healthy-normal, altered, and pathological brain conditions, offers a fresh perspective on the phenomenon of Selfhood and enriches our understanding about dynamic variability "Self"-, "Me"-, and "I"-components of the Selfhood triad. We have demonstrated that all phenomenologically experienced states reported in various modes can be credibly mapped to alterations in the dynamic configuration of functional integrity of the brain SRN OMs (related to "Self"-, "Me"-, and "I"-components). In other words, any Selfhood state is characterized by varying proportions of "Self", "Me", and "I" in accordance with phenomenological manifestation of a particular mode. The three components, thus, can be viewed as variables that can have different values and weights, and their intricate interplay constitutes a sophisticated multidimensional pattern of Selfhood (Fingelkurts *et al.*, 2020; 2022). What this shows is that one's subjective identity can dynamically "shrink" or "expand", and thus the boundaries of human Selfhood must be *flexible* enough to account by the very same triad model of Selfhood for both modes of the self-consciousness, that are the normal and the pathological. This further implies that Selfhood is a "*process*" overall, and that it is only within this process that "Self", "Me", and "I" can be found. Such conceptualization closely resembles the Buddhistic understanding of self as a dynamic process of radical transformation that incorporates ultimately incommensurable multiplicity (Dockstader *et al.*, 2012). Yet another benefit of this conceptualization is "[…] that we can more clearly understand various interpretations of self as compatible or commensurable instead of thinking them in opposition" (Gallagher, 2013; p. 4).

Intriguingly, we have found that not all variations in the Selfhood components that characterize many pathological Selfhood modes are always incompatible with normal Selfhood functioning, thus indicating that some degrees of variability during neuropsychopathology may be regarded as falling within the bounds of normality. In this context, a particular pathological condition may be conceptualized as an adapted state — a new metastable regimen of brain functioning (Fingelkurts and Fingelkurts, 2022b) centered around altered neurophenomenological levels. Such adaptation is conceptualized as allostasis and is defined as an adaptive process of achieving stability (a new set point) through change (Fingelkurts and Fingelkurts, 2022b), a stability that is outside the idealized normal homeostatic neurophenomenological range. Such a system might, however, be less equipped to cope with the demands of ever-changing environment. Thus, the balanced metastable interplay between various components of complex Selfhood is essential for normotypical self-experience, and research of neuropsychopathological modes can assist in revealing the necessary boundaries of self-consciousness in general as well as their original texture in particular. On the other hand, it is hoped that a deeper comprehension of the specific ways in which disrupted dynamic configuration of various Selfhood components may underlie neuropsychopathology might point to new therapeutic targets and approaches. Furthermore, a deeper understanding of various Selfhood triad configurations may help to validate and guide the future advancement of particular forms of experiential psychotherapy as well as meditation and breathing techniques.

There are several limitations to this study[11] that should be addressed in future research. First, the number of analyzed modes was limited to 16. There is a possibility that some other mental modes (not examined here) would produce the results that would modify the generalized findings reported in the present study; therefore, the current conclusions should be considered with certain caution. This being the case, this is the first neurophenomenological study that covers such a diverse and broad range of modes using the same methodological and conceptual framework to quantify the dynamic configuration of "Self"-, "Me"-, and "I"-components that comprise Selfhood. This methodological approach enabled us to reveal peculiarities and generalities of the Selfhood triad across a multitude of different modes that could not be seen in any single study. Second, we did not consider the impact of research participants' demographic characteristics, such as comparing results by gender or age. Despite these limitations, we hope that we have been able to make a novel contribution to the field of neurophenomenological research that attempts to understand the phenomenon of self (which is an indispensable part of broader consciousness research program; Varela, 1996). In short, if we conclude that the experiential phenomenal modes and the related objective neurophysiological states are isomorphic to one another, then, it appears that a scientific method could reach the levels pertaining to the innermost, qualitative aspects of human Selfhood. Additionally, such research program that uses both phenomenological and naturalistic paradigms may help to close the gap between neuroscientific and philosophical perspectives on the self, thus contributing to a more accurate and inclusive definition of Selfhood, and bringing us one step closer to understanding its purpose and broader meaning.

[11] For the limitations of each original study that is included in the current aggregated analysis, see the references provided in the subsection "Aim of the study".

CRediT authorship contribution statement

Andrew A. Fingelkurts: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Visualization. **Alexander A. Fingelkurts**: Conceptualization, Methodology, Investigation, Resources, Data curation, Writing – review & editing, Visualization. **Tarja Kallio-Tamminen**: Methodology, Resources, Writing – review & editing.

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Conflict of interest statement

An.A.F and Al.A.F are the scientific co-founders of BM-Science that is involved in fundamental and applied neuroscience research, development of EEG-based brain analyses and well-being applications. Both, An.A.F and Al.A.F hold senior researcher positions at BM-Science. T.K.-T does not have conflict of interest.

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