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Currents of the Self: Neurophenomenological Fluidity of the Three Components of Selfhood in Prolonged Altered States of Consciousness

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Abstract:

Background: Altered states of consciousness (ASC) are known to elicit profound transformations in self-awareness. However, the temporal dynamics underlying the neurophenomenology of Selfhood during extended ASCs remain insufficiently characterized. This study investigated the temporal dynamics of Selfhood neurophenomenology during a prolonged ASC induced by Conscious Connected Breathing (CCB).
Methods: We employed a multimodal approach integrating psychometric assessments (nine questionnaires), introspective self-reports, and EEG-based measures of operational synchrony in 14 healthy participants who were experienced breathwork practitioners. The analysis focused on the dynamic trajectories of three operational modules (OMs) within the Self-Referential Network (SRN), each corresponding to distinct phenomenal aspects of complex experiential Selfhood (witnessing agency – "Self", embodied emotional agency – "Me", and reflective/narrative agency – "I") across three chronological phases of the CCB session: CHARGE, PROCESS, and INTEGRATION.
Results: CCB reliably induced significant alterations in self-consciousness, including ego dissolution, disembodiment, attenuation of the witnessing observer, and heightened experiences of unity, bliss, sacredness, and noetic insight. EEG data revealed an overall reduction in functional integrity across all three OMs, with the most pronounced disruption occurring during the CHARGE phase. Each OM exhibited distinct temporal dynamics that closely aligned with participants' introspective reports. Moreover, partial and complete mystical experience subgroups displayed divergent neurophenomenological profiles: Complete mystical states were characterized by the dissolution of "Self" and "Me", alongside amplification of "I". Given the small number of participants in these two subgroups, these distinctions should be regarded as exploratory. Despite the shifts in "Self" and "Me", and "I", the proportional configuration of the Selfhood triumvirate components remained remarkably stable across all phases. Exploratory analyses of phenomenological profile similarities suggested that CCB-induced experiences closely resembled those elicited by psilocybin.
Conclusion: These findings provide convergent evidence for the dynamic modulation yet structural resilience of the Selfhood triumvirate during CCB-induced prolonged ASCs.

Keywords:

Conscious connected breathing (CCB); Self-referential brain network (SRN); default-mode network (DMN); subjective sense of Self; first-person perspective; electroencephalogram (EEG); alpha rhythm; operational synchrony; functional connectivity; agency; ownership; mineness; embodiment; first-person perspective; narration; autobiography; self-consciousness.

Breath is our companion – on our travels to deep levels and wide horizons of consciousness – in search of the true self.
(Ehrmann, 2001)
[T]he concept of selfhood cannot be accurate enough if it cannot be applied to cases that deviate from the exemplar.
(Haanila, 2021)

1. Introduction

The scientific exploration of Altered States of Consciousness (ASC) – encompassing unusual (Pahnke, 1963), non-ordinary (Timmermann et al., 2023), anomalous (Cardeña et al., 2014), or mystical experiences (Winkelman, 2024) – has long fascinated researchers across various disciplines, ranging from psychology to neuroscience (Fort et al., 2025). Such states were observed long before the rise of modern science, deeply embedded in human culture, religion, and spiritual rituals (Cardeña & Winkelman, 2011; Grof, 2019), and are in fact widespread in general populations (Fischer et al., 2025). Despite this long-standing interest, conceptual clarity remains limited, and no widely accepted classification or taxonomy of ASCs has yet emerged, although recent efforts have moved the field closer to this goal (Cardeña et al., 2025; Fort et al., 2025). With the expansion of scientific inquiry, we are beginning to better understand the nature and underlying mechanisms of these altered states (Winkelman, 2024; Cardeña et al., 2025).

While much of the existing scientific literature focuses on short-term or acute altered states (Fort et al., 2025), there is a growing recognition of the importance of studying the temporal dynamics of long-lasting ASCs (Lewis-Healey et al., 2024). These prolonged ASCs – such as those experienced during extended meditation retreats, deep hypnotic trances, or extended psychedelic sessions – offer a unique window into the mechanisms of consciousness and Selfhood. Their extended duration allows complex internal dynamics to unfold over time, revealing how consciousness and self-awareness evolve and transform in ways that short-lived states cannot capture (see also Sandilands & Ingram, 2024; Lewis-Healey et al., 2024; Cardeña et al., 2025). For example, extended meditation practices can lead to profound transformations in self-awareness and perception that unfold progressively, offering insights into how the mind adapts and restructures itself in sustained states of altered consciousness (Ataria et al., 2015; Ehmann et al., 2025b). Similarly, prolonged psychedelic sessions can induce deep and enduring changes in self-awareness, generating complex experiential dynamics that require extended periods of observation (Carhart-Harris et al., 2014). Despite their significance, the neurophenomenological study of long-lasting ASCs remains surprisingly underdeveloped, leaving a crucial gap in our understanding how consciousness operates in extended altered states.

Addressing this gap requires temporally focused and phenomenologically guided analyses capable of identifying brain functional changes linked to the evolving dynamics of subjective experience during prolonged ASCs. Neurophenomenology, that integrates first-person phenomenological reports with third-person neuroscientific data (Varela, 1996; Gallagher, 2003 Lutz & Thompson, 2003; Fazelpour & Thompson, 2015), is particularly well suited for this purpose. By combining subjective experiences with objective measurements of brain activity, researchers can begin to map the temporal evolution of consciousness in these states (Lewis-Healey et al., 2024). This research program is particularly relevant to the broader study of consciousness and self-experience (Timmermann et al., 2023), offering a powerful framework for disentangling the various aspects and functional components of self-consciousness (Haanila, 2021).

Modern phenomenological methods now provide systematic tools for investigating and quantifying the evolution of phenomenological experiences over time (Gallagher & Sørensen, 2006). While still comparatively limited within the broader ASC literature, these methods have already generated rich phenomenological data on the *temporal dynamics of prolonged* ASC (Sandilands & Ingram, 2024). For example, in the context of psychedelic experiences, it is well documented that subjects under psychedelic drugs progress through distinct stages over time, exhibiting varying degrees of change along a perception-hallucination continuum characterized by increasing arousal and ego dissolution (Preller & Vollenweider, 2018; Rankaduwa & Owen, 2023). Importantly, this rapid growth of phenomenological data has outpaced empirical neurophysiological research on the *temporal dynamics of prolonged* ASCs. This disparity highlights the need for neurophenomenological studies to bridge this gap.

Alterations in the sense of self are central to ASC experiences and often lead to profound personal transformation (Fingelkurts et al., 2022). These alterations may involve experiences of disembodiment, fragmentation or dissolution of self, anomalies of self-reflective thought, a sense of timelessness, or the deconstruction of autobiographical history (Kallio & Revonsuo, 2003; Josipovic, 2010; Blumenfeld, 2012; Berkovich-Ohana et al., 2013; Ataria et al., 2015; Windt, 2015; Wittmann, 2015; Millière, 2017; Nour & Carhart-Harris, 2017; Glicksohn & Ben-Soussan, 2020; Ehmann et al., 2025a). In light of this diverse empirical evidence, we proposed the term *Altered State of Selfhood* (ASoS) to describe these experiences (Fingelkurts et al., 2022). ASoS refers to systematic, measurable deviations in one or more components of Selfhood relative to an individual's baseline organization of self-related experience. An ASoS is present when the structure, dynamics, or experiential qualities of these components are transiently altered in a manner distinguishable from ordinary waking self-experience, whether arising spontaneously, induced through specific practices, or elicited pharmacologically. This definition aligns with established approaches to defining ASC, in which an altered state is characterized by a systematic deviation from a person's usual, ordinary, or baseline mode of conscious experience (Revonsuo, 2006). Similar to broader ASCs, ASoSs are transient, reversible, and intrinsically non-pathological (Fingelkurts et al., 2022), although they may accompany neuropsychopathological symptom complexes (Fingelkurts & Fingelkurts, 2025).

Previously, we conceptualized *experiential Selfhood* as "[…] 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 in-variance of a narrative self over time […]" (Fingelkurts & Fingelkurts, 2022, p. 182; see also Fingelkurts et al., 2020; p. 23 for further discussion). This definition reflects a productive dialogue among contemporary philosophers of mind, phenomenologists, and cognitive neuroscientists[1] (Gallagher, 2000; Churchland, 2003; Metzinger, 2003; Zahavi, 2005; Damasio, 2010; Seth et al., 2012; Velmans, 2014; Musholt, 2015; Klein, 2016; Northoff, 2016; Millière, 2020). In this context, Selfhood stands as the most fundamental and intrinsic core of being an independent and free agent, dynamically uniting multiple elements such as embodiment, affective states, executive functions, attention, general intelligence, intentionality, and other features within the common intra-subjective frame of first-person givenness (Fingelkurts & Fingelkurts, 2023).

1.1. Triadic Model of Complex Experiential Selfhood

Building on recent advances in understanding the brain's *self-referential network* (SRN) (Kim, 2012; Molnar-Szakacs & Uddin, 2013; Andrews-Hanna et al., 2014; Fox et al., 2015; Davey et al., 2016; Northoff, 2016), and empirical evidence supporting the functional specialization of its three main sub-networks (Uddin et al., 2009; Andrews-Hanna et al., 2010; Fingelkurts & Fingelkurts, 2011; Sestieri et al., 2011), a *three-dimensional construct model of complex experiential Selfhood* was proposed (for a brief history and details, see Fingelkurts et al., 2020). This model integrates neuroscientific data (Fingelkurts & Fingelkurts, 2011; Northoff, 2016) with phenomenological insights (Varela, 1996; Gallagher & Zahavi, 2012) and aims to operationalize core aspects of self-experience in a way that bridges neuroscience, subjective experience, and philosophy (Chiong, 2011; Northoff, 2014).

The triadic model of Selfhood posits that the brain's SRN comprises three spatially distinct yet functionally interlinked operational modules (OMs) – one anterior and two bilateral occipito-parieto-temporal subnets – identifiable through electroencephalogram (EEG)-based operational synchrony analysis (Fingelkurts & Fingelkurts, 2008, 2011, 2015). Each of the three OMs consists of a set of brain regions that exhibit strong EEG functional connectivity within the given OM (Fingelkurts & Fingelkurts, 2011). These

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[1] Historically, one of the earliest systematic discussions of the self was offered by William James in The Principles of Psychology (1890). His distinction between the "I" and the "Me" influenced subsequent scholarship, inspiring generations of thinkers to refine, expand, and challenge his framework. While many contemporary studies focus on the "Me" aspect of Selfhood, others emphasize the self-experience of being a knower and agent – the "I" (see Christoff et al., 2011). From a more philosophical perspective, some scholars discuss the "physical self", the "experiential–enactive self", or the "narrative self" (for an overview, see Vago & Silbersweig, 2012). However, these perspectives are typically not integrated within a single operational framework. In contrast, the Triadic Model of Complex Experiential Selfhood employed in this study captures a dynamic, multifaceted pattern arising from the interaction of three specialized modules within the brain's self-referential network. These modules underpin core phenomenological aspects of Selfhood: witnessing, embodiment, and self-reflection (Fingelkurts et al., 2020).

SRN OMs correspond to three phenomenologically distinct aspects of Selfhood: first-person agency, embodiment, and reflection (Gallagher, 2000; Zahavi, 2002; Hohwy, 2007). This framework aligns with Gallagher's "pattern theory of self" (2013), which views the self as an emergent, multi-faceted pattern of separate yet closely related qualities characterizing self-referential processing that together form a unified sense of self (Fingelkurts & Fingelkurts, 2011; see also Legrand & Ruby, 2009 and Gallagher & Daly, 2018). According to the triadic model of Selfhood (see Fingelkurts et al., 2020):

(i) Anterior SRN OM – Witnessing Observer ("Self"): Linked to the *phenomenal* first-person perspective and agency, this frontal module represents the *phenomenal,* non-conceptual core in the act of knowing itself (Blanke & Metzinger, 2009; Velmans, 2014). It facilitates the sense of being directly and immediately present as the center of a phenomenal multimodal perceptual reality (the focus of one's phenomenal experience or a sensed "centre of gravity"; Velmans, 2014) and thus "could be a passive observer, who just witnesses events, perceptions, or thoughts in its implicit first-person mode of givenness […]" (Fingelkurts et al., 2020, p. 4). The functional integrity of this module is modifiable, as seen in meditation (Fingelkurts et al., 2016a,b), spontaneous short-lived altered states (Fingelkurts et al., 2022), psychopathologies like depression or post-traumatic stress disorder – PTSD (Fingelkurts & Fingelkurts, 2017a, 2018), and in patients with disorders of consciousness (Fingelkurts et al., 2012, 2016c; Fingelkurts & Fingelkurts, 2017b).

(ii) Right posterior SRN OM – Representational-Emotional Agency ("Me"): This module underlies the *embodied* self – the experience of being localized within bodily boundaries – and is associated with affective states and emotional autobiographical memory (Damasio, 1999; Panksepp & Northoff, 2009). It represents a *purely geometrical first-person perspective* originating within the body representation, signifying an egocentric spatiotemporal self-model (Blanke & Metzinger, 2009). Additionally, it links to interoception and exteroceptive sensory processing, enabling the experience of being a self in the world (Seth et al., 2012; Limanowski & Blankenburg, 2013; Apps & Tsakiris, 2014). Disruptions in this module manifest in conditions such as vegetative/unresponsive states, PTSD, depersonalization, or advanced meditative and altered states associated with the dissolution of bodily boundaries (for an overview, see Fingelkurts et al., 2023).

(iii) Left posterior SRN OM – Reflective Agency ("I"): Related to *narrative* self-awareness, this module supports inner speech, autobiographical memory, and self-reflection (Damasio, 1999; Gallagher & Zahavi, 2015). This self-reflected form of the conceptual self "[…] provides the basis for explaining the often-discussed invariance of Selfhood over time" (Fingelkurts et al., 2020, p. 5). It requires linguistic and conceptual capacity and is shaped by social and cultural factors (Kirmayer & Crafa, 2014; Frith & Metzinger, 2016; Gallagher & Daly, 2018). Impairments in this module are linked to schizophrenia, depression, PTSD, and brain injury, but it can also be intentionally modulated through practices such as meditation (for an overview, see Fingelkurts et al., 2023).

In this model, Selfhood is not a static entity but an emergent, dynamic, and multifaceted pattern arising from the interaction of three specialized modules within the brain's SRN. Each module underpins a core phenomenological aspect of Selfhood – witnessing, embodiment, and self-reflection[2] (Fingelkurts et al., 2020). However, "since complex Selfhood is a dynamic pattern, where different features or aspects may have different weights and configuration of the relations (with constant dynamic readjustments), the coherent sense of Selfhood can be diminished or enhanced and may also acquire some particular nuanced qualitative flavor" (Fingelkurts et al., 2020, p. 23), such as during ASoSs (Fingelkurts et al., 2022).

Indeed, brief but vivid episodes of ASoSs reported by experienced meditators during meditation revealed that each ASoS was associated with a transient neurophenomenological perturbation of various components of Selfhood (Self-Me-I) (Fingelkurts et al., 2022). Specifically, "a concrete altered state of Selfhood [was] determined not only by the direction of functional change in Selfhood components, but also by the magnitude of this change and a mutual relation between these components" (Fingelkurts et al., 2022, p. 275). However, because these episodes were short-lived, it was not possible to examine the unfolding dynamics of Selfhood components over the course of an ASoS.

To address this gap, the present study *aimed* to investigate the temporal dynamics of the integrity of the three SRN modules corresponding to the three components of Selfhood ("Self," "Me," and "I") by tracking their evolution during prolonged ASoS. By focusing on extended altered states, we aimed to gain deeper insights into the temporal structure of self-consciousness and the internal mechanisms that shape the evolving experience of the Selfhood. To this end, we employed a controlled breathing practice – Conscious Connected Breathing (Orr & Ray, 1977; De Wit & Moraes Cruz, 2021; Bahi et al., 2024; Havenith et al., 2025) – as a non-pharmacological ASoS induction method. To avoid misunderstanding, we note that the present study did not seek to test the hypothesis that Conscious Connected Breathing (CCB) can induce altered ASCs. Instead, our study leveraged this well-established capacity of CCB as a methodological tool to investigate how different components of Selfhood dynamically evolve during prolonged ASC in relation to a restful baseline.

1.2. Conscious Connected Breathing (CCB)

All breathwork practices involve a controlled, volitional breathing pattern (Grof, 2019). Among these, techniques that elevate respiratory rates beyond typical resting levels – classified as High Ventilation Breathwork (HVB) – have been used since antiquity for spiritual and healing purposes. They are observed across diverse cultural traditions, including Hinduism, Tibetan Buddhism, Shamanism, Inuit practices, Sufism, and Native American rituals (Fincham et al., 2023).

Although all breathing practices can induce ASCs, these states tend to be more pronounced in HVB techniques that employ continuous, unbroken breathing over extended durations without breath-holding, rest

[2] Converging evidence from several lines of research suggests that witnessing ("Self"), embodiment ("Me"), and self-reflection ("I") represent fundamental, primary aspects of phenomenal experiential Selfhood. These three aspects are (i) present from early childhood (Woźniak, 2024; for a brief review, see Fingelkurts & Fingelkurts, 2025), (ii) expressed across the entire continuum of functioning, from health to pathology (Fingelkurts et al., 2023), and (iii) transdiagnostic (Fingelkurts & Fingelkurts, 2025).

periods, or major tempo changes (Hick, 1962; Dowling, 2000). Indeed, empirical findings indicate that HVB can evoke mystical-type experiences comparable to those induced by psychedelics such as psilocybin, including ego-dissolution, "oceanic boundlessness," and the transcendence of time and space, reflecting profound alterations in self-perception (Griffiths et al., 2011; Fincham et al., 2023; Havenith et al., 2025; Kartar et al., 2025).

Despite HVB's potential to reliably induce ASCs, significant variation exists among these breathwork techniques in terms of their safety, practical accessibility, and suitability for controlled laboratory conditions. For the present study, we selected CCB for several reasons: (i) *Established use and safety*: CCB has been practiced within holistic health paradigms for over four decades (Gutfreund, 2009). It has shown consistent efficacy in reducing symptoms of depression, anxiety, and PTSD (Rajski, 2002; Lalande et al., 2012; De Wit & Moraes Cruz, 2021; Bahi et al., 2023), with no significant adverse effects reported in the literature (Gutfreund, 2009; Carr, 2014; Lalande et al., 2012; De Wit & Moraes Cruz, 2021; Fincham et al., 2023); (ii) *Technique*: The core of CCB is an uninterrupted breathing rhythm – there are no pauses between inhalation and exhalation (Fincham et al., 2023). The inhale is active and slightly intensified, while the exhale is completely passive and relaxed (De Wit & Moraes Cruz, 2021). This passive exhalation minimizes excessive carbon dioxide loss from the blood, a frequent outcome in hyperventilation scenarios where exhalation is forceful, such as in the Holotropic Breathwork (Rubin, 1983). The gentle, continuous flow of CCB resembles the natural respiration of newborns and is characteristic of balanced breathing (Farhi, 1996). This differentiates CCB from classical pranayama techniques in Hatha Yoga (Iyengar, 1988) and from more intense techniques like Holotropic Breathwork, which frequently result in cathartic expression (Grof, 1993); (iii) *Practicality for laboratory study*: A CCB session typically lasts about 60 minutes – approximately half the duration of Holotropic Breathwork sessions (Havenith et al., 2025) – making it a more feasible intervention for controlled experimental settings; (iv) *Universality*: Unlike many psychological or therapeutic interventions that rely on language proficiency, educational background, cultural familiarity, or social context, CCB transcends these boundaries. It can be practiced effectively regardless of a participant's linguistic abilities, cultural or ethnic background, level of formal education, or socioeconomic status (Rajski, 2002); (v) *Potential to elicit extended ASoSs*: Similar to extended meditation practices (Ataria et al., 2015; Ehmann et al., 2025b,c) and prolonged psychedelic sessions (Carhart-Harris et al., 2014), CCB can spontaneously induce enduring and intense alterations in states of Selfhood (ASoSs) (De Wit et al., 2018; Bahi et al., 2024), which are central to the objectives of the present study. Compared to meditation, however, CCB may offer a more practical and accessible method for investigating ASoSs under controlled laboratory conditions. This is because eliciting such non-ordinary states through meditation often requires participants with rare and highly developed meditative expertise – skills that typically demand substantial time and dedication to cultivate. Meanwhile, the use of psychedelics for scientific purposes remains constrained by legal, medical, and financial limitations, further underscoring the utility of CCB as a viable alternative experimental tool to induce ASoS. An additional advantage of non-pharmacological methods like CCB is their controllability: if needed, the altered states can typically be terminated within seconds or minutes, unlike pharmacologically induced ASCs, which are often less easily interrupted (Schmidt & Fejer, 2021).

By utilizing CCB, this research aimed to explore how distinct components of Selfhood – such as witnessing agency (“Self”), embodied emotional agency (“Me”), and reflective/narrative agency (“I”) – transform and interact during prolonged ASoSs. Additionally, this approach was expected to yield deeper insights into the underlying structure and dynamics of Selfhood triumvirate itself. To reach this aim, we conducted a neurophenomenological, naturalistic investigation of *spontaneously induced* prolonged ASoSs via CCB. Brain activity was recorded using EEG from healthy volunteers both before and during CCB sessions conducted in naturalistic environment. These physiological measurements were complemented by introspective experiential reports and psychometric assessments. We hypothesized that CCB would modulate the three facets of Selfhood, thereby inducing ASoSs operationalized as systematic phenomenological and neural deviations from each participant’s resting-state baseline. Specifically, we expected measurable changes in the experiential qualities and corresponding EEG dynamics associated with witnessing agency (“Self”), embodied emotional agency (“Me”), and reflective/narrative agency (“I”), as well as shifts in their temporal interactions throughout the session. This on–off, within-subject design is widely recognized as a valid approach in neurophenomenological and psychedelic research, offering greater power to identify neural correlates associated with phenomenological experiences (Schmidt & Fejer, 2021). Importantly, this design allows each participant to serve as their own control, thereby reducing inter-individual variability and strengthening the interpretability of the observed changes.

2. Materials and methods

2.1. Participants

For the purpose of this study, adult volunteers were recruited from a pool of individuals who regularly attended CCB sessions at their own initiative through the “Breathwork Finland” school in Helsinki. Given the limited existing literature on CCB and considering the previous findings highlighting result similarities between the altered states induced by CCB and those elicited by psychedelics (Bahi et al., 2024; Havenith et al., 2025), we estimated our sample size based on comparable psychedelic research, which typically employ relatively small cohorts of 15–25 participants (Prugger et al., 2022), yet have consistently yielded reliable and replicable findings. We therefore considered this range appropriate for the present investigation. Initially, 18 participants were enrolled.

Each potential participant was assigned a personal pseudonymized code, used both during the session and for completing a secure online pre-session questionnaire hosted on the BM-Science Center’s website. This questionnaire, administered two weeks prior to the study session, collected demographic and health-related information to identify potential exclusion criteria. All responses were pseudonymized – participants were identified solely by their study codes. Eligible participants were then emailed a detailed "Subject Information Sheet," which outlined the study purpose and structure, including session length, EEG measurements, and pre- and post-session questionnaires. Subsequently, each participant took part in a phone interview with a certified instructor from the "Breathwork Finland" school (co-author TR of this study). This interview confirmed eligibility, addressed any overlooked exclusion criteria, and provided an opportunity for participants to ask questions about the study.

Participants were eligible if they met the following criteria: were aged between 18 and 65 years; had good general neurological and psychological/psychiatric health; had participated in at least 5 prior CCB sessions and intended to continue further; exhibited minimal movement automatisms during past CCB sessions; and provided written, signed informed consent. Exclusion criteria included any history of neurological and/or psychiatric disorder; Beck Depression Inventory (BDI; Beck et al., 1961) score ≥ 17 and/or Hamilton Anxiety Rating Scale (HAM-A; Hamilton, 1959) score ≥ 15; brain trauma/concussion within the past month; history of epilepsy; serious somatic illness within the past year; asthma; brain aneurysm; arterial hypertension; heart arrhythmia; pregnancy (for female participants), or use of medication affecting brain activity.

Four participants were excluded from the study: one due to unrelated health issues, two withdrew because of time constraints, and one was excluded due to disqualifying medication use. The final sample comprised 14 participants (11 males, 3 females; mean age = 42.73, SD = 5.57). All but one participant were right-handed, none had a history of neurological or mental illness, and all had completed more than 11 years of education.

This study was conducted in accordance with the World Medical Association's Declaration of Helsinki and adhered to the ethical guidelines set by the BM-Science – Brain and Mind Technologies Research Centre Review Board. The study was not preregistered. All procedures were fully explained prior to participation, and written informed consent was obtained from each participant. Participants were informed that they were free to withdraw from the study at any time. Data use for scientific studies was authorized through the consent and approved by the Review Board (study reference ID: "Breathwork&Self-Me-I_EEG-2022"). No financial compensation or other incentives were offered to participants.

2.2. Procedure

Prior to the CCB session, participants were reminded of the standard instructions to refresh their understanding of the CCB technique and to ensure proper breathing. The verbal guidance (delivered by the co-author TR) included the following:

> "*Breathe in a smooth, uninterrupted flow. Avoid pauses or breaks – your breath should move continuously, like a gentle wave. Through Breathwork, you may experience a range of emotional and physical sensations. These may include spontaneous emotional releases such as laughter, crying, or anger; feelings of bliss or emotional relief; physical sensations like tingling, energy surges, or*

cramping; a sense of bodily dissolution or expansion beyond the body; or the perception of unusual sounds or colorful lights. Allow these experiences to unfold. It's important to surrender to the process, no matter how unusual it may seem. You might revisit early-life memories (possibly even birth-related) or traumatic experiences, or recall vivid events you don't consciously remember. All of this is normal and safe. Trust the process – you are never alone. The guides are present and attentive to you and your body throughout the session."

During the entire experimental procedure, participants lay comfortably on a mat in a supine position, with their heads on small pillow, wearing an EEG cap and electrodes (Figure 1). The room lighting was dimmed. The full experimental session began with a 6-minute resting-state baseline period, followed by responses to a set of questionnaires related to this baseline condition, and then by an approximately 60-minute CCB session. Afterward, participants provided reports on their subjective experiences during the CCB session and completed post-session questionnaires regarding the CCB session (Figure 2). EEG recordings were conducted (by the co-author AnAF) throughout both the baseline and CCB session, with participants' eyes closed.

Figure 1. Example of the typical session setup (photo). Permission granted by the subject.

Each participant completed a single ~60-minute CCB session, a familiar experience given their regular practice. The CCB session followed a four-stage structure (Figure 2) and was conducted under continuous one-to-one guidance by certified CCB instructors (co-authors TR and ER). This individualized guidance ensured both the correct execution of the breathing technique and participant safety. One instructor (co-author ER) provided breathing guidance using minimal verbal input during the session – brief prompts (e.g., one- or two-word encouragements) – to help participants maintain a connected breathing rhythm, adjust their breath if necessary, or adopt an open, accepting attitude toward their inner experience. The other instructor (co-author TR) continuously annotated all behavioral and breathing variations throughout the session, using a chronometer synchronized with the start of the CCB session and the concurrent EEG recording.

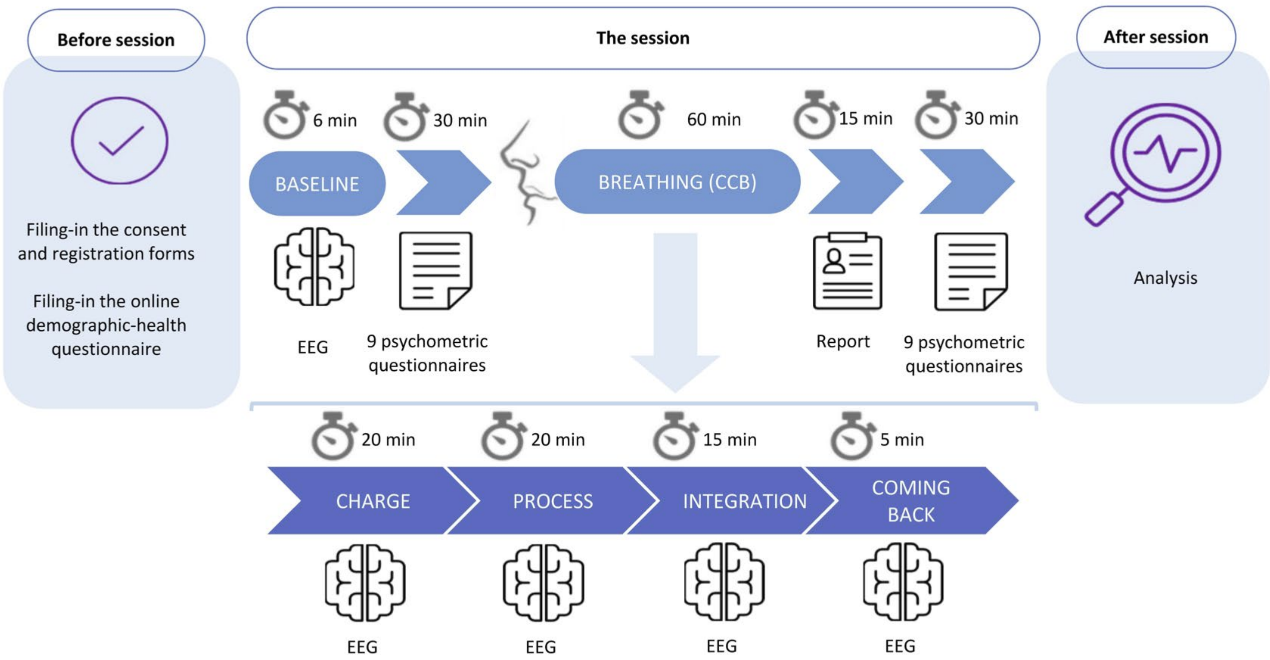

Figure 2. Schematic illustration of the study design and timeline. Abbreviations: EEG – electroencephalogram recording; CCB – conscious connected breathing. The icons are adapted from the Icon Collections developed by Insilico Medicine (2024), used under the CC BY-NC-SA license, which permits free use, remixing, and transformation.

During the first stage of the CCB session (CHARGE), participants were instructed to breathe rhythmically using a specific connected circular breathing pattern, characterized by continuous breathing with no pauses between inhalation and exhalation, whereas inhalation is active, while exhalation is a passive release. This stage is associated with progressive activation of the sympathetic branch of the autonomic nervous system (ANS) (Havenith et al., 2025). At the second stage (PROCESS), the connected breathing continued, with variations in breathing rhythm corresponding to shifts in mental states. From this stage onward, parasympathetic nervous system activation progressively began (Lalande et al., 2012; De Wit & Moraes Cruz, 2021). In the third stage (INTEGRATION), participants were instructed to relax and allow their breath to return to its natural rhythm without conscious control, facilitating integration of the preceding experience. Finally, in the fourth stage (COMING BACK), participants were gently guided back to ordinary awareness and invited to reflect on their experience during the session. All instructions were verbal.

Potential confounding factors typically present in breathwork sessions (so called "context"; Hartogsohn, 2016; Rebecchini, 2021) – such as emotionally evocative music, social support from the group and pre-session sharing, and "social contagion" effects from other participants expressing intense emotions (e.g., crying, screaming, or laughing) – were intentionally excluded. Instead, each session was conducted in silence with a single participant at a time. This controlled setting allowed us to closely match the baseline and CCB conditions, isolating the specific influence of breathing that induces the ASoS from the effects of context.

2.3. Self-reports and questionnaires

The current study employed a neurophenomenological design (Gallagher, 2003; Lutz & Thompson, 2003; Fazelpour & Thompson, 2015), integrating EEG recordings with first-person reports from the same participants, along with their responses to a set of standardized questionnaires. A resting condition – eyes closed with no tasks – served as the *baseline* to which participants referred while completing the first round of questionnaires (Figure 2). Subsequent subjective reports and second-round questionnaire responses were collected immediately after the completion of the CCB session (see Figure 2). This timing was chosen to enhance the reliability of the self-reports (Windt, 2013) and minimize distortions due to episodic memory errors, misremembering, or confabulation (Jack & Roepstorff, 2002; Windt, 2013; see also Corneille & Gawronski, 2024).

Following the CCB session, participants first completed an *Introspective Self-Report* (ISR) in a face-to-face interview, where they were asked to describe their experience during the CCB session in their own words. They were explicitly encouraged to immerse themselves in the memory of the experience, while suspending any prior beliefs or theories about the experience and avoiding the generation of new mental associations or post-hoc analyses. Beyond these guidelines, there were no restrictions on the content of their reports. During the interview, participants were guided to identify in which phases of the CCB session the phenomenal experiences they described had occurred. The ISRs were guided, audio-recorded, and then transcribed by co-author TR. The transcripts (translated from Finnish into English) were subsequently subjected to qualitative content analysis (by co-author AnAF) to identify the phenomenological characteristics of the experience during their temporal unfolding. Importantly, the temporal assignment of specific experiential contents to the CHARGE, PROCESS, or INTEGRATION phase was made by the participants themselves during the guided interview, prior to transcription and qualitative analysis. The subsequent content analysis therefore operated on portions of the reports in which temporal markers had already been identified by the participants.

A set of nine standardised questionnaires, selected for their phenomenological relevance to this study, included: (1) *Sense of Agency Rating Scale* – SOARS (Polito et al., 2013), evaluating “Involuntariness” and “Effortlessness” factors. (2) *Rumination-Reflection Questionnaire* – RRQ (Trapnell & Campbell, 1999), estimating “Rumination” and “Reflection” factors. (3) *Five Facet Mindfulness Questionnaire* – FFMQ (Baer et al., 2006), assessing only the “Observing” factor. (4) *Embodiment Questionnaire* – EQ (Aymerich-Franch et al., 2015), evaluating “Body Ownership”, “Self-Location”, and “Physical Agency” factors. (5) *The Sense of Body* – SB (an in-house questionnaire inspired by Pope & Singer, 1978; Winget, & Kramer, 1979), assessing “Body Image”, “Body Perception”, and “Body Orientation” factors. (6) *The Sense of Time* (ST) *and Thought Speed* (TS) (another in-house questionnaire based on the same sources), evaluating "Here and Now", "Future", "Past", "Sense of Time was Ordinary", "Sense of Eternal/Everlasting Now", "Sense of Time Standing Still", "Sense of Time Going/Flowing Backward", "Sense of disordered/fragmented time", "Concatenation of Thoughts", "Continuity of Thoughts", and "Speed of Thoughts" factors. (7) *Ego-Dissolution Inventory* – EDI (Nour et al., 2016), estimating "Ego-inflation" and "Ego-dissolution" factors. (8) *Mystical Experience Questionnaire* – MEQ-30 (Barrett et al., 2015), evaluating "Internal Unity", "External Unity", "Noetic Quality", "Sacredness", "Positive Mode", "Ineffability", "Transcendence of Time and Space", and "Mystical Experience" factors. (9) *The 11-Dimensional Altered States of Consciousness Scale* – 11D-ASC (Studerus et al., 2010), assessing "Experience of Unity", "Spiritual Experience", "Blissful State", "Insightfulness", "Disembodiment", "Impaired Control and Cognition", "Anxiety", "Complex Imagery", "Elementary Imagery", "Audio-Visual Synesthesia", and "Changed Meaning of Percepts" factors.

2.4. EEG registration and pre-processing

EEG data were recorded throughout the entire experimental session – including both the "baseline" and "CCB" conditions – with participants' eyes closed. A 21-channel Mitsar EEG acquisition system was used, with 19 electrodes placed according to the international 10–20 system (O_1, O_2, P_3, P_4, P_z, C_3, C_4, C_z, T_3, T_4, T_5, T_6, F_z, F_3, F_4, F_7, F_8, F_{p1}, F_{p2}). The timing of EEG recordings is shown in Figure 2.

Participants were advised to abstain from caffeinated beverages on the day of recording to avoid caffeine-induced alterations in the EEG (Landolt et al., 2004). Recording parameters were as follows: linked earlobes as reference; bandpass filter: 0.5–30 Hz; notch filter: 50 Hz (enabled); sampling rate: 250 Hz; electrooculogram (EOG): 0.5–70 Hz bandpass; electrode impedance maintained below 10 kΩ.

During EEG recording, participants were instructed either (i) to relax without engaging in any specific mental activity (resting-state baseline), or (ii) to perform the CCB following the given instructions (experimental condition). In both cases, the eyes remained closed. The quality of the EEG signal was assessed through visual inspection of the raw data. Artifacts from eye opening, movements, muscle activity, and drowsiness (identified by features such as a ≥1 Hz slowing of background frequencies, vertex sharp waves, and slow eye movements) were corrected or removed using the following methods: (a) spatial filtering based on Independent Component Analysis (ICA), where components corresponding to these artifacts were zeroed (Vigário, 1997), and (b) exclusion of epochs with excessive amplitudes: overall EEG amplitude ≥ 200 µV; fast activity (20–35 Hz) ≥ 50 µV; slow activity (0–1 Hz) ≥ 50 µV.

Clean EEG data were segmented into consecutive 1-minute epochs for pre-processing. Each epoch was then bandpass filtered within the alpha frequency range (7–13 Hz) using a sixth-order Butterworth filter applied forward and backward to avoid phase distortion. As specified in our previous work (Fingelkurts et al., 2020), the alpha band was selected for the following reasons: (1) *Relevance to the SRN*: Among EEG frequency bands, alpha activity has consistently shown a strong positive correlation with SRN activity and is believed to play a primary role in its function (Laufs et al., 2003; Mantini et al., 2007; Jann et al., 2009;

Knyazev et al., 2011, 2012; Marino et al., 2019). (2) *Dominance in resting EEG*: Alpha oscillations are the most prominent rhythm in the absence of external stimuli (Klimesch et al., 2007; Palva & Palva, 2007; Başar & Güntekin, 2009; Fingelkurts & Fingelkurts, 2010, 2014). (3) *Developmental significance*: Alpha activity is absent in children under 3 years of age (Başar & Güntekin, 2009; Praetorius, 2009), and gradually matures by around age 7 (Matousek & Petersen, 1973; Benninger et al., 1984; Gasser et al., 1988). This developmental trajectory mirrors that of the SRN (Fair et al., 2008; Thomason et al., 2008) and correlates with the development of awareness of "point of view" and thus "perspective taking" (Gopnik & Slaughter, 1991; Povinelli et al., 1996; Asendorpf, 2002). (4) *Phenomenological relevance in norm, pathology, and altered states*: Alpha-range synchrony within the three modules of the SRN used in this study significantly correlates with variations in three aspects of self-consciousness across clinical, altered, and meditative states (Fingelkurts et al., 2023; Fingelkurts & Fingelkurts, 2025).

2.5. Estimation of the SRN OMs and their synchrony strength

Building on our previous EEG studies (for a review, see Fingelkurts et al., 2023), we used a predefined set of nine cortical areas previously identified as components of the SRN to estimate operational synchrony strength within three SRN OMs: *frontal OM* (includes F_3–F_z–F_4 EEG locations); *left posterior OM* (T_5–P_3–O_1); *right posterior OM* (T_6–P_4–O_2). These nine regions were not selected arbitrarily; rather, they consistently emerged as part of the three most stable, task-independent spatiotemporal patterns, each exhibiting exceptionally strong operational synchrony. This finding was replicated in two independent studies with participants from different nationalities and across two sensory modalities, reinforcing its robustness (Fingelkurts & Fingelkurts, 2011). A concise review of research linking these EEG electrode positions to their corresponding cortical brain areas can be found in Fingelkurts et al. (2016b, p. 30). These mappings were validated using an EEG–MRI sensor alignment system and an automated cortical projection algorithm (Koessler et al., 2009).

To estimate operational synchrony strength within each OM, multiple stages of data processing were necessary. These stages, detailed in Fingelkurts & Fingelkurts (2008, 2015), are summarized below.

The *first step* involved adaptive EEG segmentation. Each local EEG signal was segmented into a temporal sequence of quasi-stationary periods using adaptive segmentation, which identifies naturally occurring *rapid transitional periods* (RTPs) – abrupt amplitude shifts indicating *intrinsic boundaries* between distinct segments. These segments are considered reflections of transient operations performed by local functional neuronal assemblies (Fingelkurts et al., 2010, 2013). Synchronization of segment boundaries across spatially distributed local EEG signals reflects temporal coupling of these neuronal operations – termed *operational synchrony* – which underlies the formation of coherent, complex mental operations (Fingelkurts et al., 2010, 2013; see also Freeman & Kozma, 2000; Kozma & Freeman, 2009; Freeman et al., 2015).

During the *second step*, synchrony strength was estimated. Operational synchrony was calculated as the statistical level of RTPs coupling between two or more local EEG recordings (Fingelkurts & Fingelkurts, 2008, 2015). In other words, it quantifies how often and how reliably the EEG segments, framed by the RTPs, occur in synchrony across spatially distinct electrodes, reflecting the coordination of functional neuronal assemblies underlying integrated cognitive or conscious processes (Fingelkurts and Fingelkurts, 2008, 2015). Synchrony values near zero indicate random alignment, while significant positive or negative values reflect synchronization or decoupling, respectively – compared against stochastic thresholds derived via EEG segment shuffling simulations (for details, see Fingelkurts & Fingelkurts, 2008, 2015). The absolute value of this measure reflects the *strength* of functional connectivity: the higher the value, the stronger the functional connection.

Operational Modules (OMs) were identified from synchrocomplexes (SCs) – sets of EEG locations in which all pairs within the set exhibit statistically significant operational synchrony across every 1-minute epoch. Each OM is defined by a stable, recurring SC (Fingelkurts & Fingelkurts, 2008, 2015).

An increase in synchrony within an OM (reflecting functional integration) indicates stronger coordination among the involved neuronal assemblies, which, in the context of this study, may correspond to more integrated or unified aspects of self-related processing. Conversely, a reduction in synchrony reflects weaker coordination, suggesting that the functions supported by that OM (e.g., witnessing, embodiment, or narration) are less prominently expressed. Within the neurophenomenological framework, such reductions may signal a loosening or dissolution (depending on the degree of integration) of certain self-related processes. For empirical evidence of a causal relationship between functional integrity (measured by EEG operational synchrony) within the three brain SRN OMs and the phenomenological expression of the three aspects of the Selfhood triumvirate, see Fingelkurts et al. (2020).

Although sensor-level EEG analyses are often criticized for susceptibility to volume conduction, the operational synchrony measure used here has been rigorously validated through simulation studies. These studies demonstrated that the measure reflects underlying cortical morpho-functional organization rather than being confounded by volume conduction, EEG power fluctuations, or reference electrode choices (Fingelkurts & Fingelkurts, 2008, 2015).

2.6. Statistical Analysis

The strength of functional connectivity within individual OMs was evaluated using EEG operational synchrony analysis, as briefly outlined in the previous section. Differences in synchrony strength between the BASELINE condition and the CCB session – as well as across the four phases of the CCB session – were expressed as percent changes relative to the baseline. This metric directly conveys the magnitude of the observed effects and, in this respect, serves a similar function to conventional effect size indices (see Dankel et al., 2017). Statistical significance of these percent changes at the group level was assessed using a One-Sample *t*-test, with the null hypothesis stating that the change equals zero (i.e., no change). To calculate group-level averages, synchrony strength values were first averaged across all 1-minute EEG epochs within each OM for each participant and condition. These individual averages were then aggregated across all participants to obtain group means. To minimize potential contamination of carry-over effects from the adjacent third phase, data from the fourth phase ("coming back") were excluded from the analysis. As previously noted, the duration of such carry-over effects remains unknown at this time (Chowdhury et al., 2023).

In addition to EEG measures of OMs, changes in psychometric test scores (excluding the 11D-ASC questionnaire) were assessed using the same approach – percent changes relative to the baseline. To ensure the comparability of scores measured in various questionnaires, all scores were first converted to percent values for each examined phenomenological factor. Statistical significance of these percent changes at the group level was assessed using a One-Sample *t*-test. For the 11D-ASC, the percentage maximum score was calculated per participant and dimension, and further averaged across all participants. Group differences in the means for the 11D-ASC dimensions between the BASELINE condition and the CCB session were assessed using a Wilcoxon Signed-Rank Test. Comparisons between participant subgroups for the 11D-ASC dimensions were conducted using a Mann-Whitney *U* Test.

Correlations between changes in OMs' integrity and questionnaire scores were analysed using Pearson correlation.

For all tests, the statistically significant results were reported at $p < .05$.

Given the theoretical structure of the Selfhood model, supported by previous empirical research (Fingelkurts et al., 2022), the three major aspects of Selfhood (witnessing, embodiment, and narration) were treated as conceptually and functionally distinct. Our primary neurophenomenological hypotheses concerned the pattern of independent enhancement, diminishment, or stability across these three aspects during prolonged ASC induced by CCB. Because these aspects do not constitute a single joint null hypothesis and are not expected to covary in a uniform direction, no correction for multiple comparisons was applied to the three domain-level analyses. This approach is consistent with arguments by Perneger (1998) and Rubin (2021), who note that multiplicity adjustments are unnecessary when tests address independent theoretical questions, and with García-Pérez's (2023) caution that "multiple testing should not be mistakenly generalized to testing any diversity of unconnected nulls over the course of a study" (p. 10).

However, the phenomenological assessment also included 32 finer-grained experiential dimensions. Although these dimensions represent distinct facets related to Selfhood, prior work in both breathwork and psychedelic research shows that several subscales – particularly those related to ego dissolution, ineffability, sacredness, noetic quality, and body-related alterations – can exhibit intercorrelations. In this context, we applied a false discovery rate (FDR) correction to this set of 32 comparisons using the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995), which is well suited for correlated psychological and experiential measures, as it maintains substantially greater statistical power than Bonferroni-type family-wise error corrections (Benjamini & Yekutieli, 2001) and is widely recommended for multidimensional, interdependent, and high-dimensional datasets (Efron, 2010). We report both uncorrected and FDR-corrected *p*-values.

3. Results

3.1. Phenomenological experiences during CCB

As anticipated, the CCB session reliably induced[3] a robust and sustained altered state of consciousness (ASC) across all participants (Figure 3). The global ASC percentage maximum score was calculated from three key dimensions of the 11D-ASC (Studerus et al., 2010) – "Oceanic Boundlessness," "Anxious Ego Dissociation," and "Visual Restructuralization" (Dittrich, 1998) – with subsequent averaging across all participants. This composite score showed a dramatic, statistically significant increase compared to the resting baseline state (Wilcoxon Signed-Rank Test: $z = -3.29$, $p = .0009$; see Figure 3).

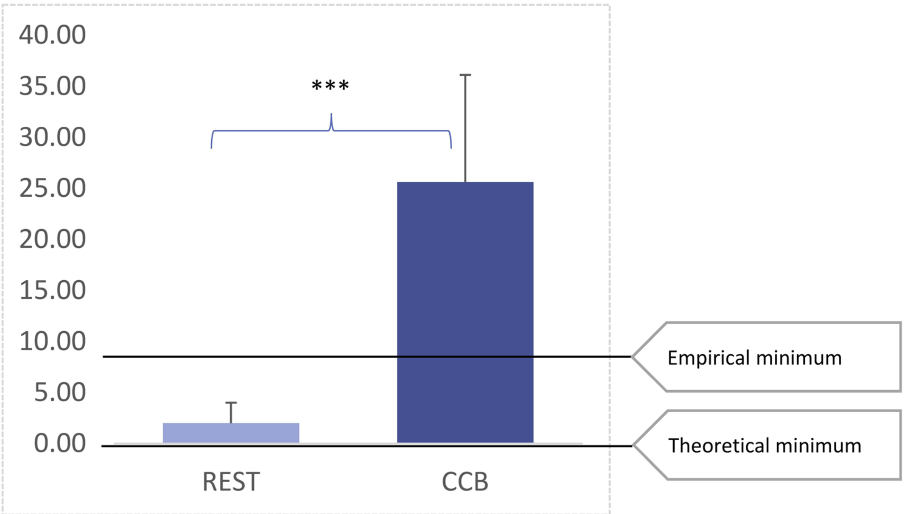

Figure 3. Global altered state of consciousness (ASC) elicited by Conscious Connected Breathing (CCB), as measured using the 11-Dimensional Altered States of Consciousness Scale (11D-ASC). The *Y-axis* represents the percentage maximum composite ASC score, derived from key dimensions of the 11D-ASC (see main text for details). The *X-axis* displays the two experimental conditions: REST (baseline resting state) and CCB (active breathing session). Asterisks (***) indicate $p < .001$ (Wilcoxon Signed-Rank Test). The theoretical minimum is set at "0," representing the normal waking consciousness of an individual. The empirical minimum was determined based on data from 135 healthy subjects, all in a state of normal waking consciousness (Bodmer et al., 1994).

[3] Although ASC induction was not a hypothesis under investigation in this study (as stated in the Introduction), confirming its presence in our sample was necessary to validate the subsequent analyses of altered states of Selfhood (ASoSs), which presuppose that participants actually entered a non-ordinary state relative to baseline.

Importantly, the global ASC score during the REST did not significantly differ from either the theoretical or empirical minimum values reported by Bodmer at al (1994), as indicated by One-Sample *t*-tests (t = 1.39, p = .094; t = -14.88, p = .999, respectively). In contrast, the score obtained during the CCB session showed highly significant deviation from both these minimums (t = 9.13, p = .00000003; t = 5.57, p = .00005, respectively), confirming the CCB session's effectiveness in eliciting a pronounced ASC.

Specifically, almost all eleven dimensions of the 11D-ASC scale showed the same pattern of change across conditions (see Figure 4), with the notable exceptions of "Anxiety," "Audio-Visual Synaesthesia", and "Changed Meaning of Percepts". These three dimensions did not show significant differences between the REST and the CCB session, and their scores remained within the range typically associated with ordinary waking consciousness. The most pronounced subjective effects during the CCB session were observed in the dimensions "Experience of Unity," "Blissful State," and "Disembodiment." These phenomenological factors showed statistically significant elevations compared to baseline, as confirmed by the Wilcoxon Signed-Rank Test (z = -3.18, p = .0007; z = -3.29, p = .0005; z = -3.29, p = .0005, respectively; see Figure 4),

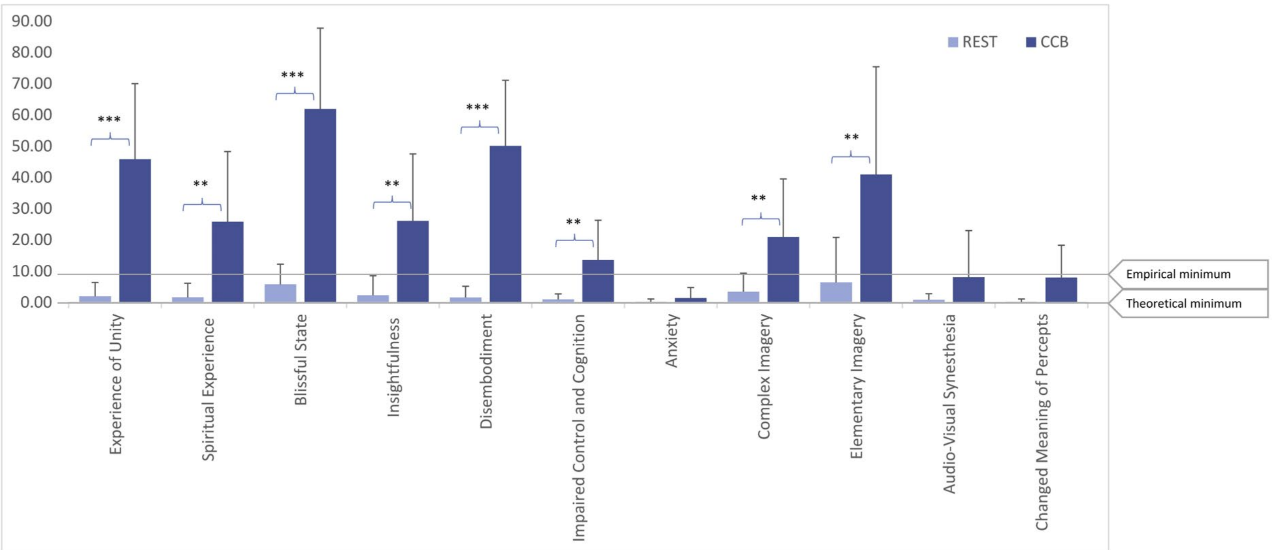

Figure 4. Phenomenological experiences elicited by Conscious Connected Breathing (CCB), as measured using the 11-Dimensional Altered States of Consciousness Scale (11D-ASC). The *Y-axis* represents the percentage maximum score per phenomenological dimension. The *X-axis* displays the specific eleven dimensions for two experimental conditions: REST (baseline resting state) and CCB (active breathing session). Asterisks (** and ***) indicate $p < .01$ and $p < .001$ (Wilcoxon Signed-Rank Test).

Similarly to the ASC global score, the MEQ total score – calculated as the percentage of the maximum possible score across all items and representing the overall intensity of the mystical experience (Barrett et al., 2015) – was significantly higher during the CCB session compared to the score obtained during the resting baseline condition (Wilcoxon Signed-Rank Test: z = -3.41, p = .0003; Figure 5). At the group level, participants reached the threshold for a complete mystical experience, as defined by Barrett et al. (2015), with total scores equal to or exceeding 60% of the maximum possible score.

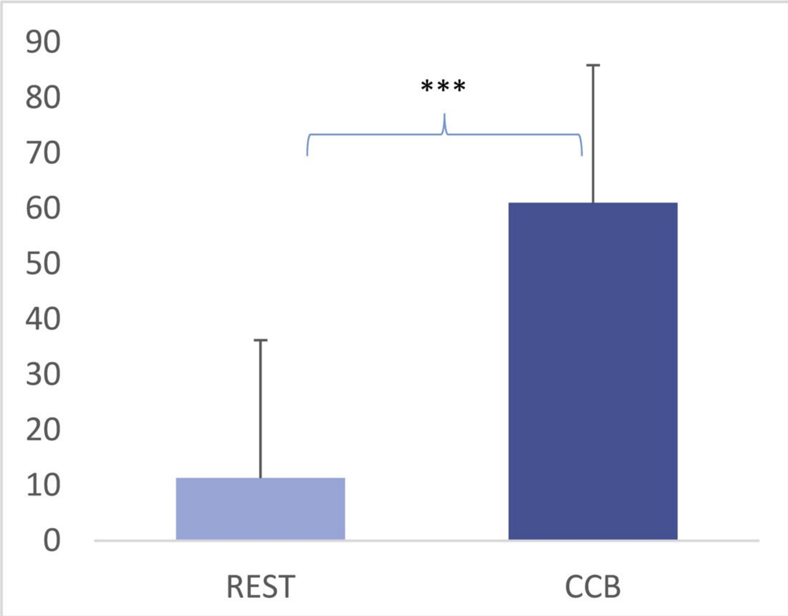

Figure 5. Overall intensity of the mystical experience elicited by Conscious Connected Breathing (CCB), as measured using the Mystical Experience Questionnaire (MEQ). The *Y-axis* represents the percentage maximum MEQ score. The *X-axis* displays the two experimental conditions: REST (baseline resting state) and CCB (active breathing session). Asterisks (***) indicate $p < .001$ (Wilcoxon Signed-Rank Test).

Participants' self-ratings across all administered questionnaires – including the MEQ subscales – revealed profound alterations in consciousness and self-awareness during the CCB session compared to the REST ordinary waking consciousness condition (Figure 6). Of the 32 assessed phenomenological dimensions, 27 showed statistically significant differences between conditions, as determined by percent change from REST to CCB and confirmed by the One-Sample *t*-test. To account for the multiple comparisons, all *p*-values were additionally corrected using the Benjamini–Hochberg False Discovery Rate (FDR) procedure. This analysis showed that the vast majority of statistically significant effects (24 out of 27) remained robust after correction. The strongest enhancements were observed in the dimensions of "Ego-dissolution," "Sacredness," "Ineffability," and "Noetic quality". In contrast, the most pronounced decreases were noted in dimensions related to embodied and temporal awareness, including "Body image," "Body orientation," "Experience of now and here," "Sence of time was ordinary," "Experience of future", and "Experience of past" (Figure 6).

Because participants naturally vary in the depth of MEQ expression, we stratified the sample using the validated 60% MEQ score cut-off (Barrett et al., 2015) to distinguish *partial* (below 60%) from *complete* (60% or higher) mystical experiences during the CCB session. This allowed us to examine whether the intensity of the mystical experience was associated with differences in the 11D-ASC scale, as well as other phenomenological and neural measures. The resulting MEQ-based groups were small (N = 6 and N = 8); therefore, all comparisons between them should be regarded as exploratory.

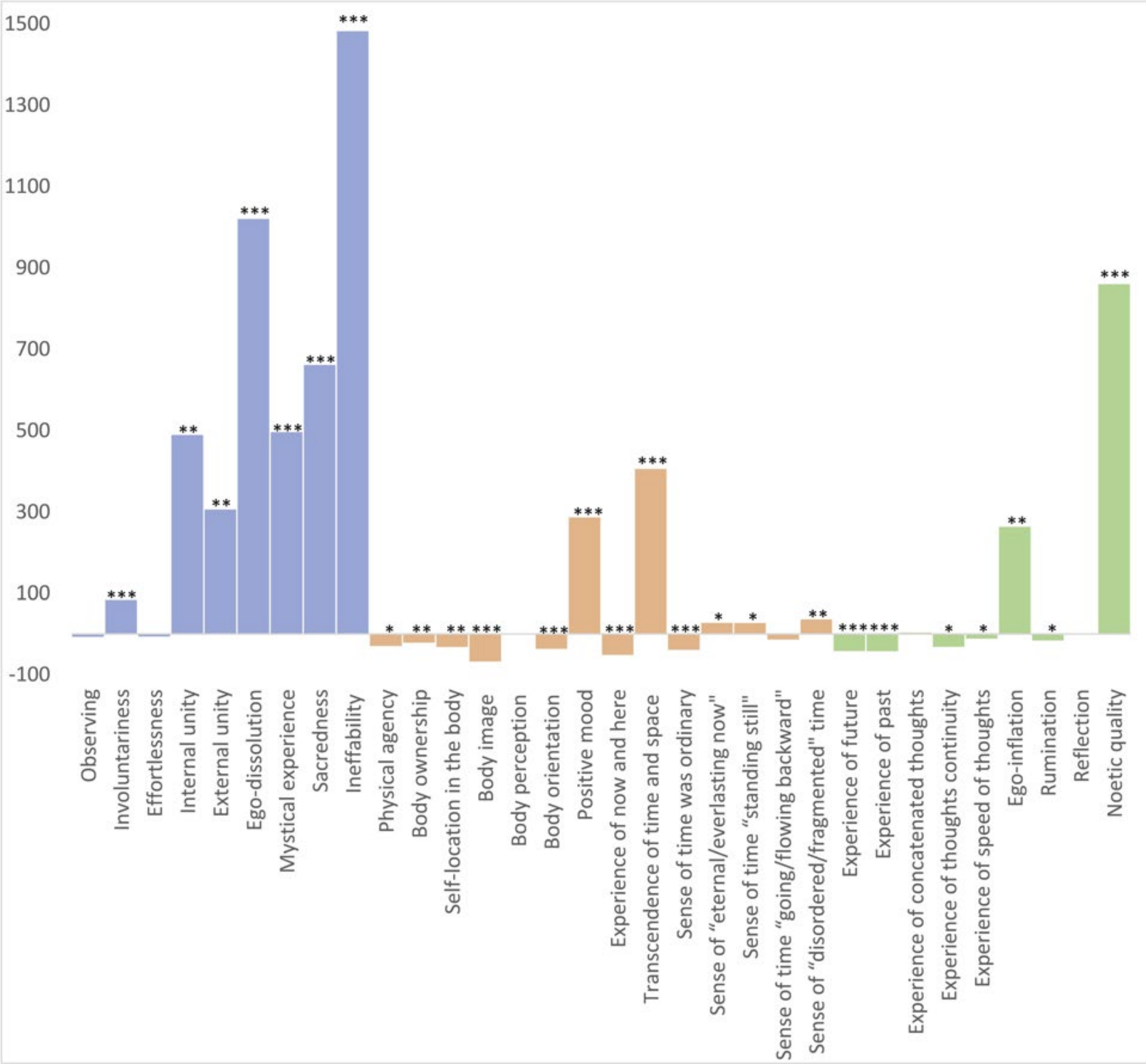

Figure 6. Subjective experience elicited by Conscious Connected Breathing (CCB), quantified as percent change from the resting baseline across 32 phenomenological dimensions. The *Y-axis* displays percent change, with "zero" indicating no deviation from baseline (REST). The *X-axis* presents the 32 dimensions assessed using nine standardized psychometric questionnaires (see main text for details). The colors blue, orange, and green denote phenomenological dimensions corresponding to the "Self," "Me," and "I" components of the Selfhood model, respectively. The grouping of questionnaire subscales into these domain–subdimension categories was informed by our previous empirical and theoretical work (Fingelkurts et al., 2020, 2022). To enhance transparency and reduce subjectivity, three co-authors independently mapped the same set of questionnaire subscales to the "Self," "Me," and "I" components based on conceptual criteria (phenomenological scope, theoretical lineage, and item content). The final assignment was retained only when all three researchers agreed. In cases where the initial classifications differed, the final decision was based on concordance between at least two researchers. This procedure ensured that the mapping reflected a reproducible consensus rather than an individual interpretive judgment. Asterisks (*, **, and ***) indicate uncorrected $p < .05$, $p < .01$, and $p < .001$ (One-Sample *t*-test against a null hypothesis of zero change). Specific statistical values for phenomenological dimensions: "Observing" ($t = -0.39$, $p = .69$; FDR corrected $p = .77$); "Involuntariness" ($t = 5.20$, $p = .0002$; FDR corrected $p = .0005$); "Effortlessness" ($t = -2.08$, $p = .06$; FDR corrected $p = .07$); "Internal unity" ($t = 3.79$, $p = .0026$; FDR corrected $p = .006$); "External unity"

($t = 2.59$, $p = .0025$; FDR corrected $p = .006$); "Ego-dissolution" ($t = -8.44$, $p = .00001$; FDR corrected $p = .00008$); "Mystical experience" ($t = 6.34$, $p = .00003$; FDR corrected $p = .0001$); "Sacredness" ($t = 3.12$, $p = .0081$; FDR corrected $p = .01$); "Ineffability" ($t = -8.44$, $p = .00001$; FDR corrected $p = .00008$); "Physical agency" ($t = -2.45$, $p = .029$; FDR corrected $p = .04$); "Body ownership" ($t = -3.35$, $p = .0052$; FDR corrected $p = .01$); "Self-location in the body" ($t = -3.81$, $p = .0021$; FDR corrected $p = .005$); "Body image" ($t = -13.76$, $p = .00001$; FDR corrected $p = .00008$); "Body perception" ($t = 0$; $p = 1$; FDR corrected $p = 1$); "Body orientation" ($t = -5.42$, $p = .0001$; FDR corrected $p = .0004$); "Positive mood" ($t = 7.21$, $p = .00001$; FDR corrected $p = .00008$); "Experience of now and here" ($t = -8.44$, $p = .00001$; FDR corrected $p = .00008$); "Transcendence of time and space" ($t = 6.34$, $p = .00003$; FDR corrected $p = .0001$); "Sense of time was ordinary" ($t = -5.84$, $p = .00006$; FDR corrected $p = .0002$); "Sense of eternal/everlasting now" ($t = 2.23$, $p = .043$; FDR corrected $p = .058$); "Sense of time standing still" ($t = 2.89$, $p = .013$; FDR corrected $p = .02$); "Sense of time going/flowing backward" ($t = 0.73$, $p = .481$; FDR corrected $p = .55$); "Sense of disordered/fragmented time" ($t = 3.15$, $p = .008$; FDR corrected $p = .01$); "Experience of future" ($t = -4.32$, $p = .0008$; FDR corrected $p = .002$); "Experience of past" ($t = -4.92$, $p = .0003$; FDR corrected $p = .0008$); "Experience of concatenated thoughts" ($t = 1.31$, $p = .211$; FDR corrected $p = .25$); "Experience of thoughts continuity" ($t = -2.46$, $p = .029$; FDR corrected $p = .04$); "Experience of speed of thoughts" ($t = -2.19$, $p = .041$; FDR corrected $p = .58$); "Ego-inflation" ($t = 2.98$, $p = .001$; FDR corrected $p = .002$); "Rumination" ($t = -2.65$, $p = .019$; FDR corrected $p = .03$); "Reflection" ($t = 0$; $p = 1$; FDR corrected $p = 1$); "Noetic quality" ($t = 6.48$, $p = .00002$; FDR corrected $p = .0001$).

Figure 7 (Panel A) illustrates the results of this comparison for the global ASC percentage maximum score. The data indicate that participants who experienced a complete mystical experience during the CCB session exhibited significantly higher levels of altered states of consciousness than those who had only a partial mystical experience (Mann-Whitney *U* Test: $z = 2.52$, $p = .0117$). Notably, the ASC scores for both subgroups during the CCB session were markedly elevated compared to the theoretical and empirical minimum values established by Dittrich & Lamparter (1991). This deviation was statistically confirmed via two One-Sample *t*-tests ($t = 6.62$, $p = .0005$; $t = 2.77$, $p = .0195$, respectively), underscoring the robustness of the CCB in inducing altered states across both groups.

Figure 7 (Panel B) presents scores across all eleven dimensions of the 11D-ASC scale for participants in the two subgroups (MEQ < 60% and MEQ ≥ 60%). Participants who achieved a complete mystical experience (MEQ ≥ 60%) during the CCB session exhibited significantly higher levels of "Experience Unity," "Spiritual Experience," "Blissful State," and "Insightfulness" compared to those who reached only partial mystical experience (MEQ < 60%) (Mann-Whitney *U* Test: $z = 2.26$, $p = .0238$; $z = 2.65$, $p = .008$; $z = 2.13$, $p = .033$; and $z = 2.00$, $p = .0435$, respectively). The same pattern was also observed for "Elementary Imagery" and "Audio-Visual Synaesthesia" (Mann-Whitney *U* Test: $z = 2.00$, $p = .0435$; $z = 2.26$, $p = .0238$, respectively).

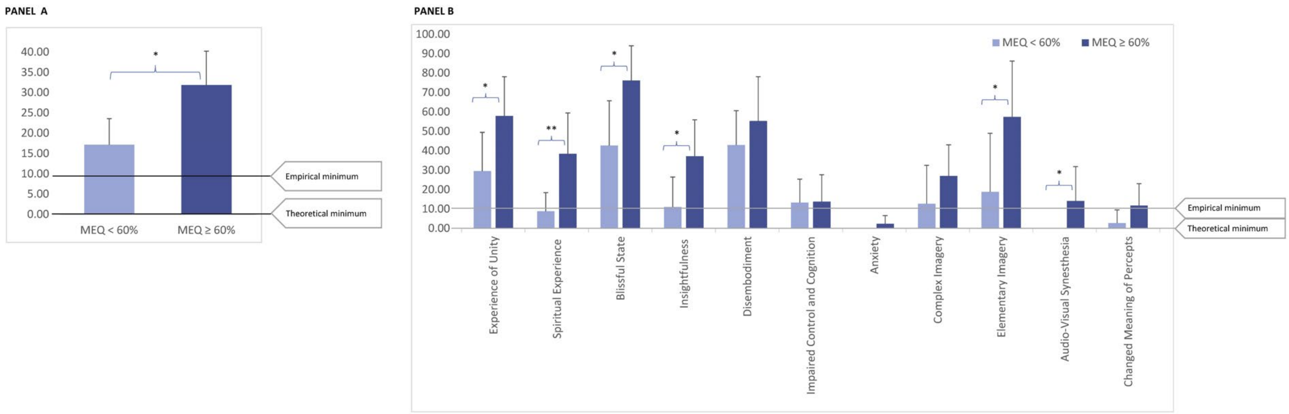

Figure 7. Phenomenological experiences elicited by Conscious Connected Breathing (CCB), as measured using the 11-Dimensional Altered States of Consciousness Scale (11D-ASC) in two subgroups, based on their Mystical Experience Questionnaire (partial mystical experience – MEQ < 60% and complete mystical experience – MEQ ≥ 60%). Panel A displays the global altered state of consciousness (ASC) composite score. Panel B presents scores across all eleven phenomenological dimensions for each subgroup. The *Y-axis* represents the percentage maximum ASC score (see main text for details). The *X-axis* displays the two subgroups for Panel A and the specific phenomenological dimensions for the two subgroups in Panel B. Asterisks (* and **) indicate $p < .05$ and $p < .01$ (Mann-Whitney *U* Test).

Figure 8 presents self-reported changes across all administered questionnaires, comparing participants with partial mystical experience (MEQ < 60%) to those with complete mystical experience (MEQ ≥ 60%) during the CCB session. A significant difference between these two subgroups was observed, as quantified by percent change from MEQ < 60% to MEQ ≥ 60% and confirmed through the One-Sample *t*-tests. Of the 32 assessed phenomenological dimensions, 27 showed statistically significant differences between the subgroups. To account for the multiple comparisons, all *p*-values were additionally corrected using the Benjamini–Hochberg False Discovery Rate (FDR) procedure. This analysis showed that the majority of statistically significant effects (16 out of 27) remained robust after correction. Participants who achieved a complete mystical experience exhibited the most substantial increases in the dimensions of “Ego-inflation,” “Noetic quality,” “Internal unity,” “Ego-dissolution,” “Sacredness,” and “Positive mood”. In contrast, the most pronounced decreases were observed in dimensions related to witnessing, embodied, and temporal awareness, including “Observing,” “Self-location in the body,” “Body image,” “Body perception,” “Experience of now and here,” “Sence of time going/flowing backword,” “Experience of future”, and “Experience of past” (Figure 8).

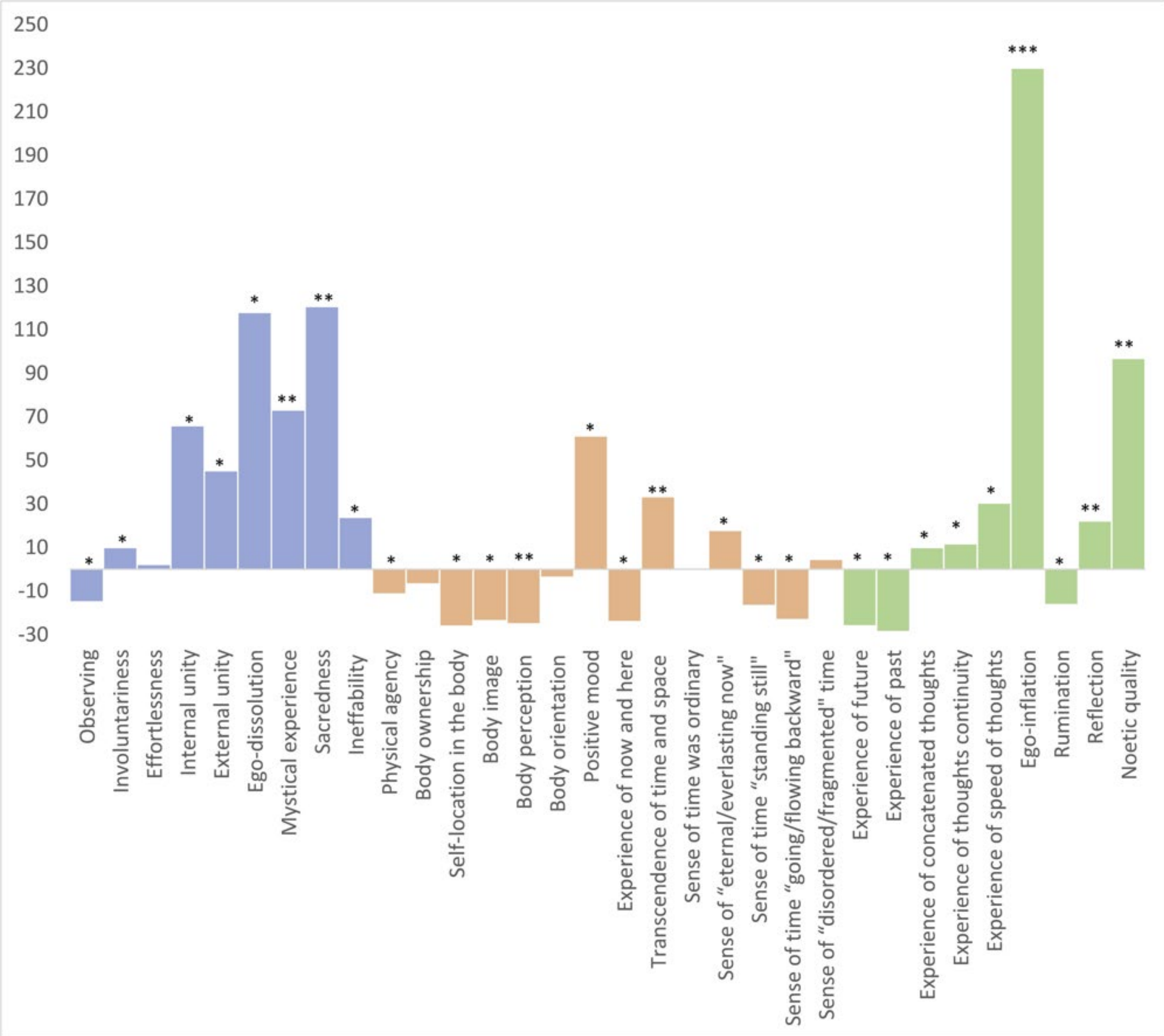

Figure 8. Subjective experiences elicited by Conscious Connected Breathing (CCB) across 32 phenomenological dimensions in two subgroups, based on their Mystical Experience Questionnaire (partial mystical experience—MEQ < 60% and complete mystical experience—MEQ ≥ 60%), quantified as percent change from the partial mystical experience. The *Y-axis* displays percent change, with "zero" indicating no deviation from the partial mystical experience. The *X-axis* presents the 32 dimensions assessed using nine standardized psychometric questionnaires (see main text for details). The colors blue, orange, and green denote phenomenological dimensions corresponding to the "Self," "Me," and "I" components of the Selfhood model, respectively. The grouping of questionnaire subscales into these domain–subdimension categories was informed by our previous empirical and theoretical work (Fingelkurts et al., 2020, 2022). To enhance transparency and reduce subjectivity, three co-authors independently mapped the same set of questionnaire subscales to the "Self," "Me," and "I" components based on conceptual criteria (phenomenological scope, theoretical lineage, and item content). The final assignment was retained only when all three researchers agreed. In cases where the initial classifications differed, the final decision was based on concordance between at least two researchers. This procedure ensured that the mapping reflected a reproducible consensus rather than an individual interpretive judgment. Asterisks (*, **, and ***) indicate uncorrected $p < .05$, $p < .01$, and $p < .001$ (One-Sample t-test against a null hypothesis of zero change). Specific statistical values for phenomenological dimensions: "Observing" (t = -2.63, p = .034; FDR corrected p = .054); "Involuntariness" (t = 2.27, p = .041; FDR corrected p = .068); "Effortlessness" (t = 0.625, p = .552; FDR corrected p = .59); "Internal unity" (t = 3.06, p = .018; FDR corrected p = .035); "External unity" (t = 2.03, p = .041; FDR corrected p = .062); "Ego-dissolution" (t = 3.06, p = .018; FDR corrected p = .035); "Mystical experience" (t = 4.97, p = .0016; FDR corrected p = .006); "Sacredness" (t = 4.97, p = .0016; FDR corrected p = .006); "Ineffability" (t = 2.62, p = .035; FDR corrected p = .054); "Physical agency" (t = 2.70,

$p = .031$; FDR corrected $p = .051$); "Body ownership" ($t = 1.50$, $p = .177$; FDR corrected $p = .21$); "Self-location in the body" ($t = 3.34$, $p = .012$; FDR corrected $p = .026$); "Body image" ($t = 2.65$, $p = .033$; FDR corrected $p = .054$); "Body perception" ($t = -4.98$; $p = .002$; FDR corrected $p = .009$); "Body orientation" ($t = 1.15$, $p = .288$; FDR corrected $p = .314$); "Positive mood" ($t = 3.18$, $p = .015$; FDR corrected $p = .028$); "Experience of now and here" ($t = 2.88$, $p = .024$; FDR corrected $p = .041$); "Transcendence of time and space" ($t = 3.67$, $p = .008$; FDR corrected $p = .019$); "Sense of time was ordinary" ($t = 0$, $p = 1$; FDR corrected $p = 1$); "Sense of eternal/everlasting now" ($t = 2.51$, $p = .04$; FDR corrected $p = .062$); "Sense of time standing still" ($t = 2.75$, $p = .028$; FDR corrected $p = .044$); "Sense of time going/flowing backward" ($t = 2.65$, $p = .033$; FDR corrected $p = .054$); "Sense of disordered/fragmented time" ($t = 0.39$, $p = .7$; FDR corrected $p = .8$); "Experience of future" ($t = 2.89$, $p = .023$; FDR corrected $p = .041$); "Experience of past" ($t = -3.24$, $p = .014$; FDR corrected $p = .028$); "Experience of concatenated thoughts" ($t = 2.84$, $p = .025$; FDR corrected $p = .043$); "Experience of thoughts continuity" ($t = 2.26$, $p = .048$; FDR corrected $p = .068$); "Experience of speed of thoughts" ($t = 2.49$, $p = .042$; FDR corrected $p = .062$); "Ego-inflation" ($t = 2.90$, $p = .023$; FDR corrected $p = .041$); "Rumination" ($t = 1.89$, $p = .044$; FDR corrected $p = .064$); "Reflection" ($t = 3.11$; $p = .009$; FDR corrected $p = .019$); "Noetic quality" ($t = 3.01$, $p = .009$; FDR corrected $p = .019$).

While questionnaire ratings offer valuable insights into participants' subjective experiences during the CCB session, they lack temporal resolution. These ratings provide a global characterization of the session as a whole and do not capture the evolving structure of experience over time – which is the focus of the present study. To examine the temporal dynamics of phenomenological experiences throughout the CCB session, we conducted a qualitative analysis of participants' Introspective Self-Reports (ISRs), in which temporal markers had already been identified by participants, focusing specifically on the temporality of these experiences.

Table 1 summarizes the reported phenomenology across the three chronological phases of the CCB session: CHARGE, PROCESS, and INTEGRATION. During the CHARGE phase, all participants reported a rapid cessation of bodily sensations and feelings, time awareness, and internal verbalization (i.e., thinking). Those with MEQ scores ≥ 60% described more intense experiences, frequently using words such as "nothingness," "oneness," and "total detachment" (see Table 1). In the PROCESS phase, participants with MEQ scores < 60% typically reported a re-emergence of bodily sensations and a sense of embodiment, though rational thought remained largely absent. In contrast, participants with MEQ scores ≥ 60%, while also noting embodiment, primarily described attempts to interpret or rationalize their experiences (thinking), often without a clear observational stance. Many used descriptions related to temporality (see Table 1). Finally, during the INTEGRATION phase, participants with MEQ scores < 60% experienced heightened embodiment and an increased capacity for observation, though rational thinking was still limited. Conversely, those with MEQ scores ≥ 60% reported cognitive processing, albeit with a diminished sense of observational clarity and somewhat present bodily sensations. Across both subgroups, many participants described profound feelings of love, peace, and joy in different phases of the CCB session (see Table 1).

Table 1. Reported phenomenology across the three chronological phases of the CCB session, as assessed by the Introspective Self-Reports.

		CCB phases		
	#	CHARGE	PROCESS	INTEGRATION
Participants with MEQ < 60%	1	Could not feel my body at all. No thoughts at all.	I was not concentrating on the breathing. Relaxed.	Body sensations and pain. Little thinking, but observing calmly.
	2	Body relaxed and I just disappeared to somewhere. It was nothing that I saw; it was more like being together with everything… I felt like I was dissolving to something… no analysis, no thinking.	I felt tingling sensations in the body that increased toward to Integration phase. No thoughts.	Felt that body became oversensitive. No thoughts, but observation: there was a feeling like enjoyment, feeling of existence.
	3	I had this feeling that I didn't sense my body. I also lost the sense of time completely. I was not thinking of anything.	It's hard to remember what happened, other than again I was experiencing those "body locks". The experience of the state was that I was just pulsating energy, and at the same time I felt a weight on my arms, like my arms were attached with tape but they were still. No emotional feelings. I didn't really experience any.	It felt like I had only the head here… and thumbs and maybe… like I had ankles. I was observing whether I was breathing correctly, and I was more as an observer and, as I realized I was observed, I was also observing myself.
	4	I was not very aware of where I was; The space seemed to disappear; I was not thinking.	I started to feel my body shaking… and it was not distressing; the shaking feeling was somehow a very pleasant feeling.	The body felt in a strange way, as if it were floating in the air. Felt like you are having a 30 cm extra layer of fat, and I felt like floating on top of that fat. For me tears came out every time, whatever was being released. There was no specific reason for the tears… it was just ALL that had being released. I started thinking about traditional things, like my father, mother; saw some old pictures from my memory when I was young… myself being in the tennis court with my dad, and I also saw in my mind a photo of my mother when she was pregnant with my little sister; I was nine years old at that time.
	5	I was zoomed out… no body, no thoughts.	Body feelings returned. I started feeling cramps.	I became more a background, thoughtless observer of what was happening around me and in my body. For example, I felt that I saw the movement of my hands in advance, before they actually moved. I did not try to move my hands.
	6	The understanding of time disappeared. I did not see particular colors but was experiencing a visual experience with more light.	The breathing became more physical, and there was more tension in the body. The understanding of time was still absent.	I was really aware of my body, physicality, and the unusual shaking in waves, like cold shakes. Always after the shaking ended, I was very conscious of what I saw or what I was aware of as a diffusely located observer. But I could not recall the thinking process.
Participants with MEQ ≥ 60%	7	That was a very quick change. Breathing happened automatically, without my will. Feeling of cold energy from inside out. No thoughts and reflections. Litle observation.	The words were not made by me – they just occurred without me noticing. The same was for the movements.	Some thinking, noticing things around and in the mind.
	8	Thinking collapsed away from the daily thoughts; The body started to feel like energy that expands into the space. Then there was a moment where it was dark, and absolutely nothing was going on (nothingness); Everything was on a pause, with a feeling bliss… and then radually I started coming back to my body.	Lots of thoughts and some observations of what was happening around me. The experience moved a little bit back to my body, and I was in my body for a while. I experienced some subtle visual figures.	Body sensations amplified; the electrodes felt as they were causing some pain to my head. Then suddenly all sounds were amplified, and I felt a strong noise. I moved in my mind, noticed thinking process, though less intense than in the previous phase. I felt that my observational skills were still somewhat decreased.
	9	The timeline disappeared completely. Total detachment from my body… hard to express the experience in words; it was something very special. Total peace and oneness.	Felt a deep state of gratitude and had an urge to rationalize this experience. But it was difficult.	I felt my body pretty much stayed in place, and thoughts started to move naturally. I felt transformed: it felt like I was a different person answering the questions after the session than at the beginning before the breathing session.
	10	I felt like something was pushing me down, and I was melting into… colors… I remember seeing colors: orange colour, and in the middle of that orange was blue.	The colors became brighter, and sometimes I saw geometrical structures. I was thinking a lot. And then, again, it was like being pulled back to a different place.	I felt my body pressed by a weight, like a blanket on me. Tried to understand this very strange experience altogether.
	11	I was not really thinking about anything; I was just going for it. I don't really remember thinking about anything. It was like nothing was happening: no feelings, no insights, nothing to follow.	After the breathing part, I… I started to think. My mind began to open to what might start to happen now; It began creating thoughts. I don't have a clear memory of it, and then the amazing euphoria and laughing appeared. I had some funny thoughts as well, like: "I'm just about to die from laughing, and it's made in the name of science; what a great way to start the day."	After I stopped laughing, I dropped back into a totally different state of consciousness; and then, with a huge wave, I came back to the surface and became ready to start speaking.
	12	I went… how would I describe it … to the other side of my own thoughts, into the lightness of being and existence. I felt a strong sense of the space disappearing. Right from the start. And also, the understanding of time disappeared. All understandings and thoughts were gone.	I felt an energy charge and how energy ran through my body from toes and fingers to the top.	Hard to explain, but it was a very strong… strong experience… and still, I felt… how would I say it… a really relaxed feeling here. It felt like my jaw was like after local anaesthesia, and tingling nicely but physically really relaxed feeling. It was difficult to make rationale sense.
	13	No thoughts and nothing to observe besides the energy that my body transformed into.	The breath was taking me somewhere. I was thinking. There was a really strong vibration between the legs; actually, the more I went into the integration period, the stronger it became… at the end, I felt this vibration from the waist down.	There was so much action. I felt like somebody was moving me, like… like someone was a little bit lifting me from the air, partially lifting the hands,… kind of partially being magnetic somehow… There was a really strong indigo blue color in my eyes, an area filled with that blue. At one moment, when I was in tears, I felt this momentary feeling of all-encompassing love,… wonderful feeling, a feeling of oneness. I was thinking.
	14	I went into a total state of nothingness. Challenging to recall now… but I really went to some other spheres… went really deep, huh.	I tried to think rationally about the experiences, but it was difficult to put the pieces together… I was somewhere in some other state, but on my mind were relationships with other people and fear towards humans… yeah… and also something else as well… it could have been some encounters from the past that came out (laughing).	This part was more bodily… the shaking and everything… involuntary movement… I can't really remember…

TIME

Abbreviations: CCB – Conscious Connected Breathing; MEQ – Mystical Experience Questionnaire. Numbers are arbitrary assigned to mask participants' personal pseudonymized codes. Participants are grouped into two subgoups based on their total MEQ score (see main text for details): partial mystical experience—MEQ < 60% and complete mystical experience—MEQ ≥ 60%.

3.2. Neurophysiological findings during CCB: Strength of operational synchrony within the triad of SRN OMs

Figure 9 illustrates the percent change in qEEG operational synchrony strength (*functional integrity*) from the baseline (REST) condition across three OMs of the brain's SRN, both for the entire CCB session (Panel A) and its distinct chronological phases (Panel B). As outlined in subsection 1.1, the triad of OMs corresponds to three phenomenological dimensions of Selfhood: "Self" – witnessing agency, "Me" – body-representational agency, "I" – reflective/narrative agency.

Figure 9. The percent change in qEEG operational synchrony strength (functional integrity) from the baseline (REST) condition across three operational modules (OMs) of the brain's self-referential network (SRN), both for the entire Conscious Connected Breathing (CCB) session (Panel A) and its distinct chronological phases (Panel B). The *Y-axis* displays percent change, with "zero" indicating no deviation from the baseline (REST) condition. The *X-axis* in Panel A presents the three OMs corresponding to the three phenomenological components of Selfhood: "Self" (witnessing agency), "Me" (body-representational agency), and "I" (reflective/narrative agency). The *X-axis* in Panel B presents the chronological phases of the CCB session: CHARGE, PROCESS, and INTEGRATION. Asterisks (*) indicate $p < .05$ (One-Sample t-test against a null hypothesis of zero change). The schematic cortex maps on

the right side of Panel B indicate the positions of OMs (dark blue shapes). The lower sections of Panels A and B illustrate the configuration (relative proportions) among three OMs associated with the three aspects of Selfhood: "Self," "Me," and "I," represented by solid horizontal bars. For these sections, the *Y-axis* is scaled according to the highest and lowest functional integrity levels observed among the three OMs, providing a comparative framework. Absolute expression values are not the focus here; rather, the emphasis is on the relative positioning of each OM within the Self–Me–I triumvirate.

At the group level, we observed a general reduction in the functional integrity across all three OMs during the CCB session. However, only the "Self" OM showed a statistically significant decrease (Figure 9, Panel A), as determined by a One-sample *t*-test ($t = -2.28$, $p = .039$). We hypothesize that the non-significant changes in the "Me" and "I" OMs reflect their dynamic modulation throughout the session. Specifically, their functional integrity may fluctuate – sometimes increasing, sometimes decreasing – depending on the phase of the CCB session. This interpretation is supported by the phase-specific data shown in Panel B (Figure 9).

The "Self" OM's functional integrity consistently declined across all phases (Figure 9, Panel B), with statistically significant reductions observed during the CHARGE (One-Sample *t*-test: $t = -2.72$, $p = .017$) and PROCESS (One-Sample *t*-test: $t = -1.88$, $p = .044$) phases. The "Me" OM showed a significant decrease in the CHARGE phase (One-Sample *t*-test: $t = -1.52$, $p = .045$), returned to baseline during PROCESS, and exhibited a non-significant increase in the INTEGRATION phase. The "I" OM also declined significantly during CHARGE (One-Sample *t*-test: $t = -1.59$, $p = .045$), followed by non-significant increases in both the PROCESS and INTEGRATION phases (Figure 9, Panel B).

Despite these fluctuations in functional integrity, the overall configuration of the OM triad ("Self"–"Me"–"I") remained largely stable throughout the REST and CCB session – both in aggregate and across its distinct phases. This stability is reflected in the consistent proportional relationships among the three OMs, as shown in the lower sections of Panels A and B in Figure 9. Across all conditions, the "Self" OM consistently exhibited the highest relative position, followed by the "Me" OM, and then the "I" OM. The only deviation from this hierarchical pattern occurred during the PROCESS phase, where the "Me" and "I" OMs exhibited equal relative positions in the proportion.

Figure 10 illustrates the percent change in qEEG operational synchrony strength (representing functional integrity) relative to the baseline (REST) condition across three OMs of the brain's SRN. Panel A presents data for the entire CCB session, while Panel B breaks down the changes across its distinct chronological phases. Figure 10 focuses on a subgroup of participants whose scores on the MEQ were below 60% of the maximum possible, indicating a *partial mystical experience* during the CCB session.

At this subgroup level, a general reduction in functional integrity was observed across all three OMs of the SRN during the CCB session, consistent with the trend seen in the overall participant cohort. However, in this case, only the "I" OM showed the strongest and statistically significant decrease in synchrony strength (Figure 10, Panel A), as determined by a One-sample *t*-test ($t = -1.64$, $p = .044$).

Further, phase-specific modulation of functional integrity was evident across all three OMs throughout the CCB session (Figure 10, Panel B). The "Self" OM's functional integrity was lowest during the CHARGE phase (One-Sample *t*-test: $t = -1.52$, $p = .044$), remained diminished in the PROCESS phase (One-Sample *t*-test: $t = -2.24$, $p = .039$), and then significantly increased during the INTEGRATION phase (One-Sample *t*-test: $t = 1.91$, $p = .044$). The "Me" OM showed a significant reduction during CHARGE (One-Sample *t*-test: $t = -1.88$, $p = .045$), returned to baseline levels in the PROCESS phase, and exhibited a non-significant increase during INTEGRATION. The "I" OM consistently declined across all three phases, with the most pronounced decrease occurring during CHARGE (One-Sample *t*-test: $t = -1.59$, $p = .045$), followed by PROCESS (One-Sample *t*-test: $t = -2.03$, $p = .043$), and then INTEGRATION (One-Sample *t*-test: $t = -1.65$, $p = .045$).

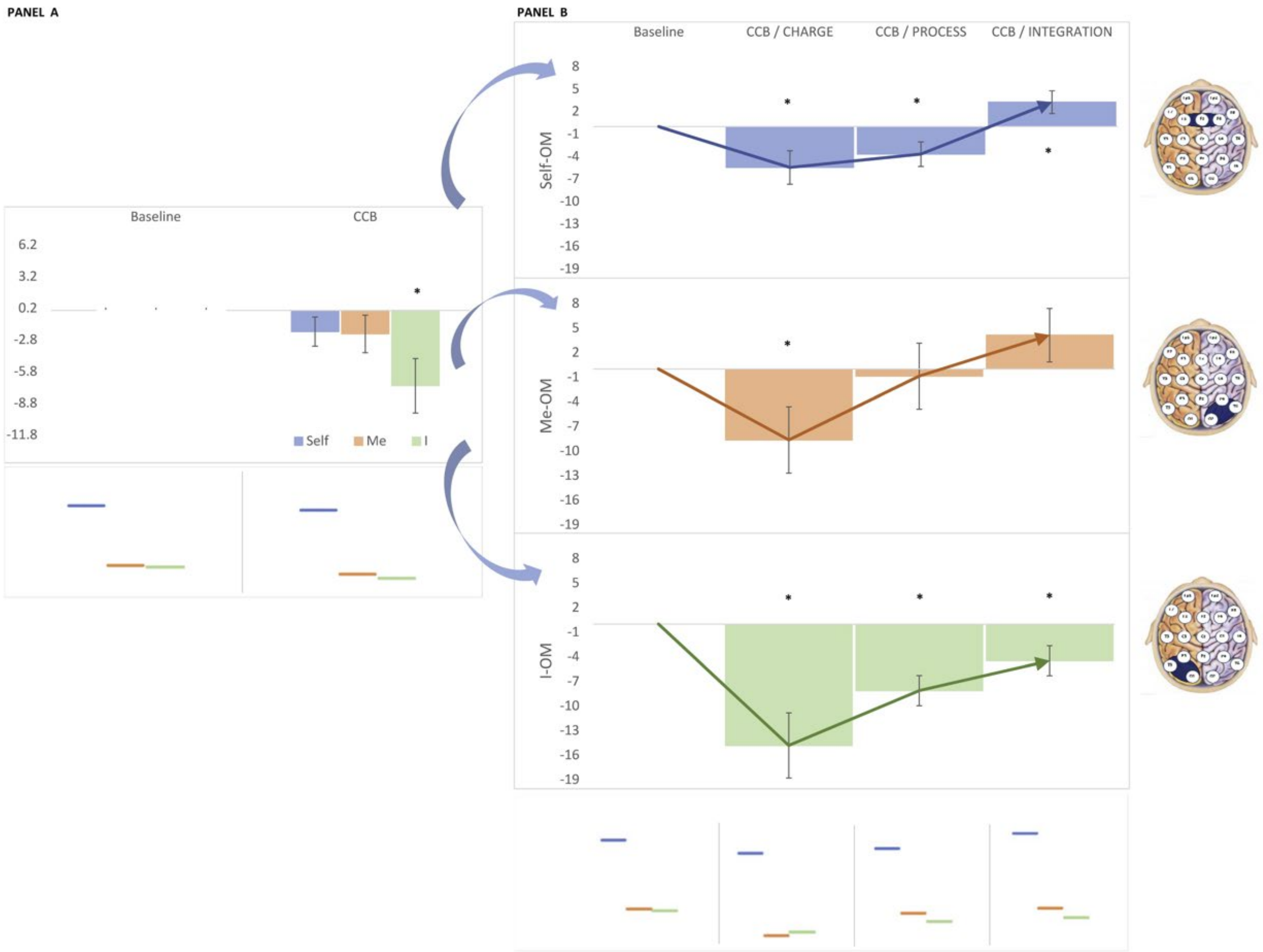

Figure 10. The percent change in qEEG operational synchrony strength (functional integrity) from the baseline (REST) condition across three operational modules (OMs) of the brain's self-referential network (SRN), both for the entire Conscious Connected Breathing (CCB) session (Panel A) and its distinct chronological phases (Panel B), for a subgroup of participants who scored < 60% of the maximum possible on the MEQ, indicating a partial mystical experience during the CCB session. The *Y-axis* displays percent change, with "zero" indicating no deviation from the baseline (REST) condition. The *X-axis* in Panel A presents the three OMs corresponding to the three phenomenological components of Selfhood: "Self" (witnessing agency), "Me" (body-representational agency) and "I" (reflective/narrative agency). The *X-axis* in Panel B presents the chronological phases of the CCB session: CHARGE, PROCESS, and INTEGRATION. Asterisks (*) indicate $p < .05$ (One-Sample *t*-test against a null hypothesis of zero change). The schematic cortex maps on the right side of Panel B indicate the positions of OMs (dark blue

shapes). The lower sections of Panels A and B illustrate the configuration (relative proportions) among the three OMs associated with the three aspects of Selfhood: “Self,” “Me,” and “I,” represented by solid horizontal bars. For these sections, the *Y-axis* is scaled according to the highest and lowest functional integrity levels observed among the three OMs, providing a comparative framework. Absolute expression values are not the focus here; rather, the emphasis is on the relative positioning of each OM within the Self–Me–I triumvirate.

For this subgroup, the overall configuration of the OM triad (reflecting the proportional relationships among “Self,” “Me,” and “I” OMs) remained largely stable throughout both the REST condition and the CCB session, as well as across its distinct chronological phases (shown in the lower sections of Panels A and B in Figure 10). Consistent with the pattern observed in the full participant cohort, the “Self” OM maintained the highest relative position across all conditions, followed by the “Me” OM, and then the “I” OM. The only deviation from this hierarchical pattern occurred during the CHARGE phase, where the “I” OM slightly exceeded the “Me” OM in relative position in the proportion.

Figure 11 highlights a subgroup of participants who scored ≥60% of the maximum possible on the MEQ, indicating a *complete mystical experience* during the CCB session. The figure presents the percent change in qEEG operational synchrony strength (representing functional integrity) relative to the baseline (REST) condition across three OMs of the brain’s SRN. Panel A displays data for the entire CCB session, while Panel B breaks down the changes across its distinct chronological phases.

At the subgroup level, a notable reduction in functional integrity was observed for the “Self” OM, representing the strongest decline (One-sample *t*-test ($t = -2.26$, $p = .043$). The “Me” OM also showed a decline, though it did not reach statistical significance. In contrast, the “I” OM exhibited a surprising, albeit nonsignificant, increase in functional integrity (Figure 11, Panel A), diverging markedly from the pattern observed in the overall participant cohort.

Phase-specific modulation of functional integrity was evident across all three OMs throughout the CCB session (Figure 11, Panel B). The “Self” OM remained consistently suppressed across all phases, with the greatest reduction during the CHARGE phase (One-Sample *t*-test: $t = -2.48$, $p = .042$), followed by a moderate decline in the PROCESS phase (One-Sample *t*-test: $t = -1.54$, $p = .045$), and a further decrease during INTEGRATION (One-Sample *t*-test: $t = -182$, $p = .045$). The “Me” OM showed a significant reduction only during the CHARGE phase (One-Sample *t*-test: $t = -2.13$, $p = .044$), returning to baseline levels during PROCESS and remaining at this level through INTEGRATION. The “I” OM decreased during the CHARGE phase (One-Sample *t*-test: $t = -2.08$, $p = .045$), followed by a significant increase in PROCESS (One-Sample *t*-test: $t = 1.59$, $p = .045$), which persisted – albeit slightly attenuated – into INTEGRATION (One-Sample *t*-test: $t = 1.64$, $p = .045$).

Despite these dynamic changes, the overall configuration of the OM triad (reflecting the proportional relationships among “Self,” “Me,” and “I” OMs) remained largely stable throughout both the REST condition and the CCB session, as well as across its chronological phases (shown in the lower sections of Panels A and B in Figure 11). Consistent with the pattern observed in the full participant cohort, the “Self” OM maintained the highest relative position across all conditions, followed by the “Me” OM, and then the

"I" OM. The only deviation from this hierarchical pattern occurred during the PROCESS phase, where the "I" OM slightly surpassed the "Me" OM in relative position in the proportion.

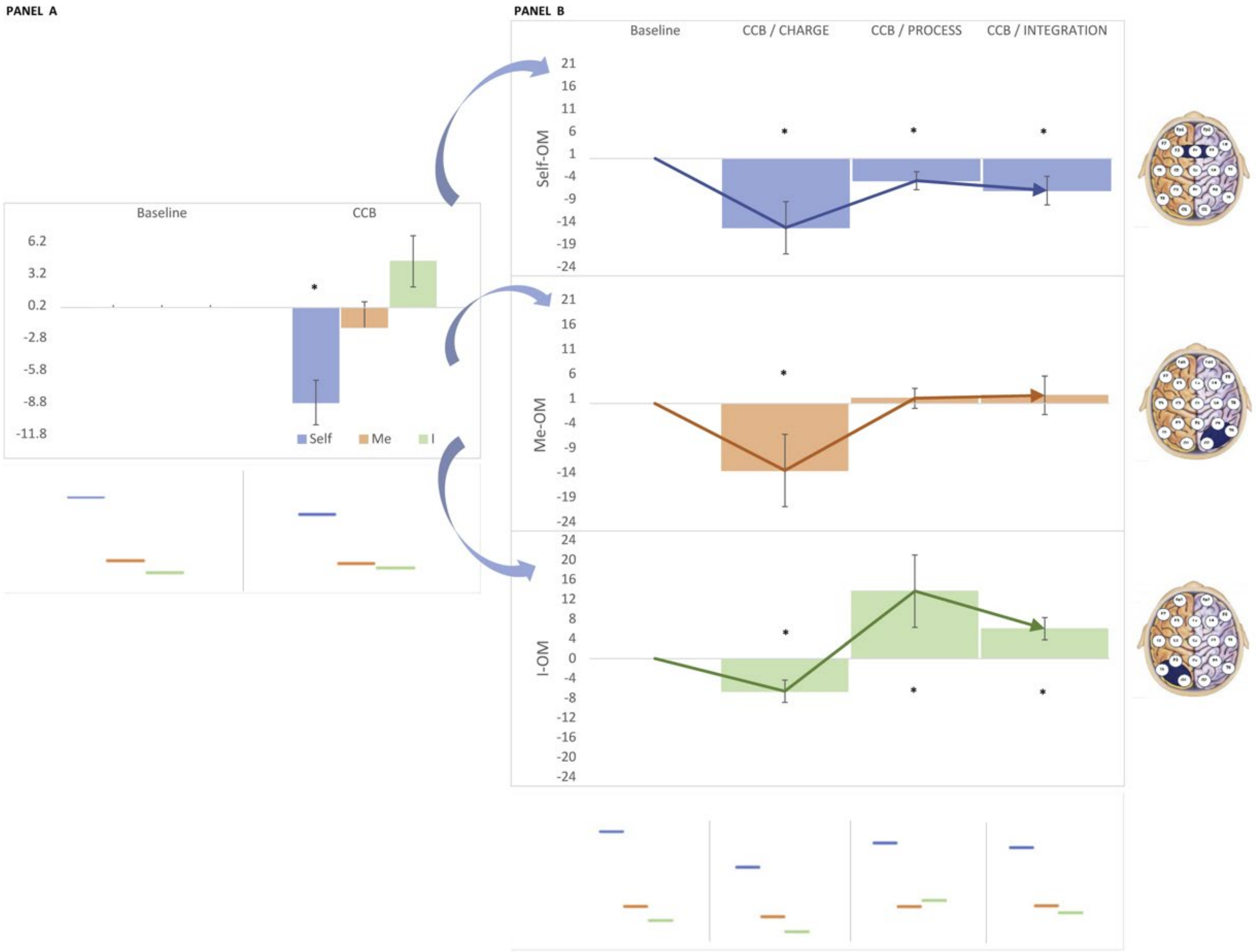

Figure 11. The percent change in qEEG operational synchrony strength (functional integrity) from the baseline (REST) condition across three operational modules (OMs) of the brain's self-referential network (SRN), both for the entire Conscious Connected Breathing (CCB) session (Panel A) and its distinct chronological phases (Panel B), for a subgroup of participants who scored ≥ 60% of the maximum possible on the MEQ, indicating a complete mystical experience during the CCB session. The *Y-axis* displays percent change, with "zero" indicating no deviation from the baseline (REST) condition. The *X-axis* in Panel A presents the three OMs corresponding to the three phenomenological components of Selfhood: "Self" (witnessing agency), "Me" (body-representational agency) and "I" (reflective/narrative agency). The *X-axis* in Panel B presents the chronological phases of the CCB session: CHARGE, PROCESS, and INTEGRATION. Asterisks (*) indicate $p < .05$ (One-Sample *t*-test against a null hypothesis of zero change). The schematic cortex maps on the right side of the Panel B indicate the positions of OMs (dark blue shapes). The lower sections of Panels A and B illustrate the configuration (relative proportions) among the three OMs associated with the three aspects of Selfhood: "Self," "Me," and "I," represented by solid horizontal bars. For these sections, the *Y-axis* is scaled according to the highest and lowest functional integrity levels observed among the three OMs, providing a comparative framework. Absolute expression values are not the focus here; rather, the emphasis is on the relative positioning of each OM within the Self–Me–I triumvirate.

3.3. Correlations between operational synchrony of OMs and phenomenological factors

We initially intended to assess correlations – using Pearson correlation coefficients – between the strength of operational synchrony in OMs and the expression of phenomenological factors, as measured by standardized questionnaires. However, this approach proved unsuitable due to substantial variability in participants' scores on the Mystical Experience Questionnaire (MEQ), which corresponded to distinct neurophysiological profiles in two subgroups: those with MEQ scores < 60% and those with MEQ scores ≥ 60% (see Figures 10 and 11).

Given this divergence, calculating correlations across the entire cohort would obscure meaningful relationships and potentially yield misleading results. To address this, we stratified the cohort into the two MEQ-based subgroups. However, the resulting sample sizes were small (N = 6 for MEQ < 60%, N = 8 for MEQ ≥ 60%), rendering statistical analysis via Pearson correlation unreliable. As noted by Aggarwal and Ranganathan (2016), correlation estimates in small samples are prone to several issues: (i) Sensitivity to outliers: In small datasets, a single extreme value can disproportionately affect the correlation coefficient, leading to inflated or deflated estimates that do not reflect the true relationship; (ii) Violation of assumptions: Pearson correlation assumes a bivariate normal distribution and a linear relationship between variables. These assumptions are more likely to be violated in small samples, where the data may not adequately represent the underlying population.

Due to these limitations, we decided not to compute Pearson correlations for either the full cohort or the stratified subgroups.

4. Discussion

The present study provides novel evidence for the *temporal dynamics* of the Selfhood triumvirate during prolonged ASoSs induced by CCB. By combining psychometric assessments, introspective self-reports (Figures 3-8, Table 1), and EEG-based measures of operational synchrony within the SRN, we demonstrate that the three OMs corresponding to witnessing agency ("Self"), embodied emotional agency ("Me"), and reflective/narrative agency ("I") undergo profound transformations, each following distinct temporal trajectories across the evolving phases of the CCB session (Figures 9-11). These findings extend previous neurophenomenological investigations of transient ASC (e.g., meditation, psychedelics, and breathwork; Lutz et al., 2008; Josipovic, 2010; Berkovich-Ohana et al., 2013; Carhart-Harris et al., 2014; Barrett & Griffiths, 2018; Millière et al., 2018; Fingelkurts et al., 2020, 2022; Bahi et al., 2024; Ehmann et al., 2025a; Timmermann et al., 2025) by revealing the *temporal alterations* of the Selfhood triumvirate.

4.1. General neurophenomenological findings

The overall subjective experience induced by the CCB session was characterised by robust and sustained alterations in consciousness and self-awareness, with global ASC and MEQ scores significantly elevated relative to baseline and theoretical/empirical minimums (Figures 3 and 5). The first-person phenomenology associated with CCB was marked by considerably heightened sense of unity, bliss, insightfulness, and disembodiment (Figure 4), as well as ego-dissolution, sacredness, ineffability, transcendence of time and space, noetic quality, and positive mood (Figure 6) – all commonly associated with spiritual and mystical experiences (Stace, 1961; Barrett & Griffiths, 2018; Winkelman, 2024).

Neurophysiologically, the CCB session as a whole was characterized by a global reduction in the functional integrity of all three modules of the SRN, with the most pronounced decrease observed in the "Self"-OM, followed by the "Me"-OM and the "I"-OM (Figure 9, Panel A). Given prior research linking this triad SRN OMs to three distinct aspects of Selfhood (Fingelkurts et al., 2020, 2022, 2023), such alterations suggest that during the CCB session participants approached an experience akin to "pure awareness" (Stace, 1961), a phenomenological state characterized by selfless, objectless, and timeless presence (Metzinger, 2020).

Indeed, the downregulation of the "Self"-OM (Figure 9, Panel A), which typically supports the experience of being a spatiotemporal witnessing point – an epistemic agent that observes both itself and the external world – likely contributed to a diminished sense of self-as-observer (Revonsuo, 2006; Trehub, 2007; Damasio, 2010; Velmans, 2014; Metzinger, 2020). In ordinary waking consciousness, this module facilitates the act of knowing by enabling attentional focus on both oneself and the world in the present moment (Gallagher, 2000; Revonsuo, 2006; Zahavi, 2005; Damasio, 2010; Metzinger, 2013; Velmans, 2014).

The concurrent downregulation of the "Me" and "I" OMs (Figure 9, Panel A), which are normally associated with embodiment and self-reflection/narration respectively (Fingelkurts et al. 2020), further contributed to the altered state by inducing subjective feeling of disembodiment, diminished self-reflection and rational thinking. Previously, we have shown (Fingelkurts et al. 2020) that participants with diminished functional integrity of the "Me"-OM do not experience themselves as full-fledged embodied entities: they exhibit a diminished automatic and immediate sense of physical agency and a first-order experiential sense of ownership (that it is *me* who owns the body; Gallagher, 2000; Tsakiris, 2010), as well as disruptions in body schema, body image, and self-location (see also Figure 6 of the present study). Similarly, it was shown previously (Fingelkurts et al. 2020), that decreased functional integrity of the "I"-OM is linked to a breakdown in coherent self-narration and temporal continuity of self across experiences, with participants experiencing fragmented thoughts devoid of a stable sense of presence or personal history (Fingelkurts et al. 2022). Indeed, our awareness of being the same person across time (a temporally extended sense of self), requires self-narration and autobiographical memory (Gallagher, 2000; Hohwy, 2007).

4.2. Temporal evolution of neurophenomenological alterations

By tracking the temporal dynamics throughout a CCB session, we demonstrated that the functional integrity of the three SRN OMs exhibited distinct and nuanced trajectories across the session's three chronological phases (Figure 9, Panel B). The functional integrity of the "Self"-OM was consistently diminished throughout all phases, with the most pronounced decrease occurring during the CHARGE phase. In contrast, the functional integrity of the "Me"-OM and "I"-OM was notably reduced only during the CHARGE phase, but showed a resurgence (albeit with differing dynamics) during the PROCESS and INTEGRATION phases.

These neurophysiological dynamics were remarkably mirrored in participants' subjective reports (see Table 1). During the CHARGE phase, participants described a rapid suspension of (a) witnessing (e.g., "*nothingness; everything was on a pause, with a feeling bliss*"; "*that was a very quick change […] little observation*"; "*it was like nothing was happening: no feelings, no insights, nothing to follow*"), (b) bodily awareness (e.g., "*could not feel my body at all*"; "*I was zoomed out… no body*"), (c) temporal orientation (e.g., "*I also lost the sense of time completely*"; "*the understanding of time disappeared*"), and (d) inner verbalization (e.g., "*I was not thinking of anything*"; "*no thoughts and reflections*"; "*all understandings and thoughts were gone*"), consistent with a collapse of the "Self", "Me", and "I" OMs (Figure 9, Panel B).

In the PROCESS phase, participants began to re-anchor into embodiment (e.g., "*I felt tingling sensations in the body*"; "*I felt a weight on my arms*"; "*body feelings returned. I started feeling cramps*") and attempted rationalization (e.g., "*I tried to think rationally about the experiences, but it was difficult to put the pieces together*"; "*I started to think. My mind began to open to what might start to happen now*"; "*lots of thoughts*"). However, their observational stance remained diminished (e.g., "*difficult to put the pieces together*"; "*I don't have a clear memory of it*"; "*I was somewhere in some other state*"). These reports align with a certain restoration of the "Me" and "I" OMs, with the "Self"-OM still suppressed (Figure 9, Panel B).

Finally, during the INTEGRATION phase, participants reported a slight increase in embodiment (e.g., "*felt that body became oversensitive*"; "*body sensations and pain*"; "*body sensations amplified*"), near-normal self-reflection (e.g., "*I started thinking about traditional things, like my father, mother, […]*"; "*I was thinking*"), and mildly diminished observational clarity (e.g., "*I can't really remember…*"; "*I became more a background, thoughtless observer of what was happening around me and in my body*"), consistent with a modest increase in the "Me" and "I" OMs, and diminished "Self"-OM (Figure 9, Panel B).

Together, these neurophenomenological findings provide convergent evidence for the temporal modulations of Selfhood components (witnessing agency – "Self", embodied emotional agency – "Me", and reflective/narrative agency – "I") across prolonged CCB-induced ASoS. Interestingly, despite these fluctuations in functional expression, the overall hierarchical configuration (i.e., proportional relationships) of the OM triad remained stable across different conditions and CCB phases, consistently following the pattern with "Self" > "Me" > "I," except during the PROCESS phase, where "Me" and "I" shared the same relative position (see lower sections of Panels A and B in Figure 9). This relative stability suggests that although the functional expression of Self-Me-I components is dynamically modulated, the structural architecture of the Selfhood triumvirate remains intact, even under profound ASoSs. This finding aligns with prior observations that even significant disruptions in self-referential processing across multiple neuropsychopathologies do not fundamentally restructure the underlying scaffold of Selfhood (Fingelkurts & Fingelkurts, 2025).

4.3. Neurophenomenological temporal evolution in complete and partial mystical experience

The subgroups analyses (Figures 7 and 8) revealed that participants who reported *complete mystical experience* (MEQ scores ≥ 60%) induced by CCB exhibited more radical phenomenological transformations compared to those with *partial mystical experience* (MEQ scores < 60%). Specifically, complete mystical experience was associated with markedly greater reductions in witnessing agency, bodily self-location, body image and perception, the experience of "now and here", and the experience of past and future. At the same time, complete mystical experience was linked to stronger expressions of ego-dissolution, spiritual experience, unity[4], sacredness, ineffability, noetic qualities, and ego-inflation, as well as heightened disembodiment, elementary imagery, and positive mood. These findings resonate with previous reports that the intensity of spiritual and mystical experiences is closely tied to the depth of phenomenological transformation, both in psychedelic states (Nour & Carhart-Harris, 2017; Millière, 2020) and in contemplative practices (Dor-Ziderman et al., 2016; Josipovic & Miskovic, 2020; Srinivasan, 2020; Ehmann et al., 2025a,c).

The neurophysiological analysis of the subgroups (Figures 10 and 11) revealed distinct profiles in the temporal dynamics of the Selfhood triumvirate, depending on whether participants reported partial (MEQ scores < 60%) or complete (MEQ scores ≥ 60%) mystical experience induced by CCB. Overall, partial mystical experience was characterised by reduced functional integrity across all three SRN OMs, with the "I"-OM exhibiting the most pronounced decrease (Figure 10, Panel A). Further, phase-specific modulation of functional integrity was observed across all three OMs throughout the CCB session (Figure 10, Panel B). Functional integrity of the "Self"-OM was lowest during the CHARGE phase, mildly reduced during PROCESS, and then significantly increased during INTEGRATION, aligning with subjective reports (Table 1; MEQ < 60%): CHARGE → "*I just disappeared to somewhere*"; PROCESS → "*It's hard to remember what happened*"; INTEGRATION → "*Observing calmly*"; "*I was more as an observer*"; "*I became more a background, thoughtless observer*"; "[…] *I was aware of as a diffusely located observer*". The "Me"-OM showed a significant reduction in functional integrity during CHARGE, returned to baseline levels during PROCESS, and exhibited a non-significant increase during INTEGRATION, paralleling the subjective reports: CHARGE → "*Could not feel my body at all*"; "*I had this feeling that I didn't sense my body*"; "*No body*"; PROCESS → "*I felt tingling sensations in the body*"; "*Body feelings returned*"; "*There was more*

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[4] The term "unity' here follows the definitions used in the Mystical Experience Questionnaire – MEQ (Barrett et al., 2015), where "internal unity" refers to a sense of unitary consciousness or merging with an ultimate reality, and "external unity" denotes a felt oneness with the surrounding environment. Both forms of unity presuppose a loosening of ordinary ego boundaries and are therefore fully compatible with ego-dissolution, representing mutually reinforcing aspects of the same experiential process.

tension in the body"; INTEGRATION → "*Felt that body became oversensitive*"; "*I was really aware of my body, physicality, and the unusual shaking in waves*". Functional integrity of the "I"-OM consistently declined across all three phases, with the most pronounced decrease during CHARGE, followed by PROCESS, and INTEGRATION, mirrored by the subjective reports: "*No thoughts at all*"; "*No analysis, no thinking*"; "*I was not thinking of anything*"; "*Little thinking*"; "*Could not recall the thinking process*"; "*I started thinking about traditional things*".

A distinct neurophysiological profile emerged for participants who reported complete mystical experiences. Overall, this experience was characterized by reduced functional integrity in the "Self"-OM and, to a lesser extent, the "Me"-OM, while the "I"-OM exhibited a pronounced increase (Figure 11, Panel A). Phase-specific modulation of functional integrity across all three OMs during the CCB session also displayed unique dynamics (Figure 11, Panel B). Functional integrity of the "Self"-OM consistently decreased, reaching its lowest values during the CHARGE phase, remaining mildly reduced during PROCESS, and then again, a further decline during ITEGRATION. These dynamics aligned with subjective reports (Table 1; MEQ ≥ 60%): "*Absolutely nothing was going on (nothingness)*"; "*That was a very quick change […] little observation*"; "*Hard to express the experience in words*"; "*Oneness*"; "*Nothing to observe*"; "*I went into a total state of nothingness. Challenging to recall now…*"; "*Some observations of what was happening around me*"; "*Hard to explain, but it was a very strong… strong experience*". Functional integrity of the "Me"-OM showed a significant reduction during CHARGE, but returned to baseline levels during both PROCESS and INTEGRATION, paralleling the subjective reports: CHARGE → "*The body started to feel like energy that expands into the space*"; "*Total detachment from my body… Total peace and oneness*"; PROCESS → "*The experience moved a little bit back to my body, and I was in my body for a while*"; INTEGRATION → "*Body sensations amplified*"; "*I felt my body pretty much stayed in place*"; "*This part was more bodily… the shaking and everything*". Functional integrity of the "I"-OM declined only during the CHARGE phase, then increased considerably during PROCESS, and showed a slight decrease but remained significantly upregulated during INTEGRATION. These dynamics were mirrored in subjective reports: CHARGE → "*No thoughts and reflections*"; "*Thinking collapsed away from the daily thoughts*"; "*All understandings and thoughts were gone*"; PROCESS → "*The words were not made by me – they just occurred*"; "*I started to think*"; "*Lots of thoughts*"; INTEGRATION → "*I tried to think rationally about the experiences, but it was difficult to put the pieces together*"; "*Some thinking*"; "*Noticed thinking process, though less intense than in the previous phase*"; "*I was thinking*".

Taken together, these findings (on partial versus complete mystical experiences) highlight the importance of distinguishing between different levels of mystical experience intensity, as they appear to engage the Selfhood triumvirate in qualitatively distinct ways. Importantly, the results suggest that a complete mystical experience is *not* merely a more intense version of a partial mystical experience, but rather a qualitatively *different* state that involves a neurophenomenological reorganization of the Selfhood triumvirate dynamics: the decrease of witnessing observer ("Self") and disembodiment ("Me") is accompanied by an amplification of the self-reflection ("I"). This increase in the expression of the "I"-aspect of Selfhood ("I"-OM) is a particularly intriguing finding. At first glance, it may seem counterintuitive, given that mystical experiences are traditionally associated with ineffability and sacredness (Stace, 1961; Barrett & Griffiths, 2018; Winkelman, 2024; see also Figure 8 of the present study), while the "I"-OM is linked to narration and self-reflection (Fingelkurts et al., 2020, 2022). However, the profound nature of complete mystical experiences often evokes a sense of awe and a deep feeling of connectedness to something greater than the self, accompanied by a noetic quality that may foster ego-inflation (Figure 8) – manifesting as "a sense of spiritual exaltation, of bliss or beatitude, of nobility and supreme value" (Taves, 2020). Paradoxically, the very realization of the experience's ineffability may provoke a strong drive to conceptualize it (for a related discussion, see also Ciaunica et al., 2021; Fingelkurts & Fingelkurts, 2022). Yet, these attempts to rationalize or narrate such profound experiences are inherently constrained by the absence of a stable witnessing-observational agency (Figures 9 and 8), which further amplifies a strong feeling of noetic quality and deep sense of intuitive insight (that have enduring transformative psychological effects; Griffiths et al., 2018; Winkelman, 2025). This interpretation aligns with subjective reports describing efforts to contextualize or make sense of the experience (often with great difficulty) during PROCESS and INTEGRATION phases, in the absence of a stable observational stance (Table 1). One may therefore propose that the "I"-OM does not merely represent ordinary self-reflection, but may also serve as a cognitive bridge that reconstitutes coherence after profound self-dissolution. Such a role aligns with prior accounts of post-egoic integration in both psychedelic (Nour & Carhart-Harris, 2017; Millière, 2020) and contemplative contexts (Josipovic, 2019), where narrative processes are recruited to articulate and stabilize otherwise ineffable experiences.

4.4. Destabilization and structural resilience of Selfhood

A particularly robust and consistent finding – observed across the entire cohort as well as within both subgroups of partial and complete mystical experiences – warrants special attention. Specifically, a pronounced decrease in functional integrity across all three SRN OMs ("Self," "Me," and "I") was evident *exclusively* during the CHARGE phase of the CCB session (see Panel B in Figures 9, 10, and 11). This neurophysiological disruption was corroborated by subjective reports (Table 1), which highlighted a diminished observing agency (linked to a diminished "Self" aspect), experiences of disembodiment and suspended temporal awareness (associated with the downregulated "Me" aspect), and a loss of reflective thinking and inner speech (pertaining to a diminished "I" aspect). One plausible explanation is that the CHARGE phase represents a neurophysiological destabilization window, during which the abrupt onset of altered breathing pattern brings about the sympathetic nervous system activation (Havenith et al., 2025) and disrupts the homeostatic balance of cortical and subcortical networks (Smigielski, 2020). Such destabilization may transiently suppress the integrative functions of the SRN, resulting in an abrupt and intense but temporary reduction in the expression of Selfhood components. Independent research on subjective experiences during CCB and Holotropic breathwork further supports this interpretation, showing that the most intense experiential phenomena tend to occur during the initial phase of the session, followed by a gradual decline in intensity during the latter half (Havenith et al., 2025).

Importantly, although each component of the Selfhood triumvirate ("Self," "Me," and "I") showed clear modulation during the CCB-induced altered state, these changes unfolded in a coordinated manner that preserved the proportional relationships among them (as shown in the lower sections of Panels A and B in Figures 10 and 11)[5]. This proportional stability indicates that the three components did not fluctuate independently but varied in a structurally constrained fashion, maintaining the characteristic configuration of the OM-triad. Such a pattern is consistent with the previously proposed hypothesis of Selfhood as a proportionate, metastable, and homeostatically regulated system (Fingelkurts & Fingelkurts, 2025), in which the three aspects may shift in absolute magnitude while retaining their internal ratio. The present findings therefore suggest that even substantial experiential perturbations (such as those accompanying partial or complete mystical experiences) do not disrupt the deeper organizational architecture of Selfhood. Instead, the triadic structure appears to operate as a resilient neurophenomenological scaffold that remains preserved across resting, altered, and previously documented pathological states (Fingelkurts & Fingelkurts, 2025). Furthermore, a recent study (Fingelkurts & Fingelkurts, 2026) demonstrated exceptionally high intra-individual stability and reliability in the overall functional configuration of the Selfhood triumvirate, that was not moderated by the interval between assessments, participants' age, or the presence of somatic or psychopathological conditions. Such enduring stability suggests trait-like properties of the neurophenomenological pattern of self-experience and may reflect an evolutionarily conserved constraint that ensures coherence and continuity of Selfhood despite dynamic fluctuations in its moment-to-moment experiential expression.

A natural question concerns the point at which Selfhood would cease to be preserved. While the present study cannot define such thresholds, our previous work with patients with disorders of consciousness suggests that Selfhood becomes functionally disrupted when the operational integrity of all three OMs drops substantially, particularly when the "Self"-OM falls to levels indistinguishable from stochastic activity. This provides at least one empirical example of a limit condition in which the proportionate triadic structure of Selfhood collapses (for details, see Fingelkurts & Fingelkurts, 2025).

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[5] This pattern cannot be attributed to any mathematical property of the OM-extraction procedure, which derives OMs solely from statistically significant synchrocomplexes without any algorithmic "knowledge" of their phenomenological assignment; thus, no computational feature enforces a Self > Me > I ordering. Furthermore, a regional functional configuration similar to the Selfhood triumvirate was also reported in an independent study by Thatcher et al. (1986), who used a different analytical method (EEG coherence) and found that the functional integrity of frontal cortical regions was greater than that of posterior regions, and higher in the right hemisphere than the left. The persistence of the triadic proportion – even when the three OMs did not change in parallel (for example, when one OM increased while the other two decreased, see also Fingelkurts & Fingelkurts, 20025) – therefore reflects a genuine neurophysiological property of the self-related OMs rather than an artifact of the measurement structure or of uniform suppression.

4.5. Phenomenological parallels between CCB and psychedelics: An exploratory analysis

Our analysis, based on standard questionnaires (MEQ-30 and 11-DASC), indicates that the altered phenomenology observed during the CCB session (characterized by ego dissolution, experience of unity, spiritual and mystical experience, bliss, sacredness, and noetic quality) appears to closely resemble that reported for psychedelic substances (e.g., Barrett & Griffiths, 2018; James et al., 2020; Hirschfeld & Schmidt, 2021; Timmermann et al., 2025), aligning with previously reported studies comparing the effects of CCB and psychedelics (Bahi et al., 2024; Havenith et al., 2025). To estimate this similarity quantitatively, we drew on data from the Altered States Database (ASDB; see Prugger et al., 2022), which contains reference scores for the 11-DASC in participants administered standard therapeutic doses of psychedelics. Because 11-DASC scores can vary considerably across studies (even for the same psychedelic compound), we employed Pearson correlation coefficient analysis to assess the degree of similarity between the 11-DASC profile elicited by the CCB session in our study and those reported for different psychedelic compounds in the ASDB.

As shown in Table 2, this exploratory analysis revealed that only psilocybin, administered at dosages of 315 mcg/kg (Smigielski et al., 2019) and 30 mg (Madsen et al. 2019), produced a phenomenological profile that was statistically similar to that induced by the CCB session in our study. Across both interventions, the highest sum score was consistently observed in the dimension of *Oceanic Boundlessness* (traditionary considered a defining aspect of any ASC; Kartar et al., 2025), followed by intermediate score in *Visionary Restructuralization*, and the lowest score in *Dread of Ego Dissolution*. This resemblance suggests that CCB breathwork and psilocybin administration may engage comparable neuropsychological mechanisms, potentially underpinning their shared capacity to promote psychological well-being and mental health. Indeed, both interventions have demonstrated therapeutic potential in alleviating symptoms of anxiety, tension, and depression (Carhart-Harris et al., 2018; Raison et al., 2023; de Wit & Moraes Cruz, 2021; Fincham et al., 2023; Bahi et al., 2024).

Table 2. Pearson correlation coefficients between the subjective experiences elicited by the CCB session and those reported for various psychedelic compounds in the Altered States Database (ASDB), as assessed using the 11-Dimensional Altered States of Consciousness (11D-ASC) questionnaire.

Compound	Dosage	Source	R	p-values	Significance
Psilocybin	315 mcg/kg	ASDB	0.8468	0.001007	<0.01
Psilocybin	30 mg	ASDB	0.6858	0.019822	<0.05
Psilocybin	225 mcg/kg	ASDB	0.494	0.122482	n.s.
Psilocybin	20 mg/70kg	ASDB	0.5094	0.109486	n.s.
Mescaline	800 mg	ASDB	0.5764	0.063439	n.s.
Mescaline	475 mg	ASDB	0.1572	0.644363	n.s.
Mescaline	400 mg	ASDB	0.3638	0.271406	n.s.
Mescaline	285 mg	ASDB	0.2967	0.375627	n.s.
MDA	1.4.mg/kg	ASDB	0.4917	0.124504	n.s.
Ketamine	0.5 mg/kg	ASDB	0.5454	0.082688	n.s.
DXM	400 mg/70kg	ASDB	0.5947	0.053636	n.s.
DMT	2.4 mg/min (over 120 min)	ASDB	0.5945	0.053737	n.s.
LSD	75 mcg	ASDB	0.2748	0.413467	n.s.
MDMA	125 mg	ASDB	0.5582	0.074325	n.s.

Abbreviations: DMT – Dimethyltryptamine; DXM – Dextromethorphan; LSD – Lysergic acid diethylamide; MDA – 3,4-Methylenedioxyamphetamine; MDMA – 3,4-Methylenedioxymethamphetamine.

While these findings do not establish therapeutic equivalence, they suggest that CCB may warrant future investigation as a potentially accessible and non-pharmacological option in settings where psychedelic-assisted therapy is constrained by legal, medical, or financial limitations (see also Lewis-Healey et al., 2024; Havenith et al., 2025).

5. Summary comments

This study presents the first neurophenomenological account of the temporal dynamics of the Selfhood triumvirate components during a prolonged ASoS induced by CCB. By emphasizing the temporal dimension, we were able to disentangle how neurophenomenology unfolds over time, offering a more nuanced understanding of the interplay among the three components of experiential Selfhood during long-lasting ASC. Specifically, complete and partial mystical experiences were associated with distinct neurophenomenological profiles of the Selfhood triumvirate, with unique dynamics of functional integrity in the SRN OMs closely mirroring participants' introspective reports. Although exploratory, these findings provide valuable insights and establish a promising basis for future scientific, phenomenological, theoretical, and philosophical explorations into the nature of experiential Selfhood.

We conclude with a metaphor. Selfhood is not a singular "sovereign" but a triumvirate of three "rulers" – the "Self", the "Me", and the "I" – each sharing uneasy power within a greater unity and seeking to govern the inner world in its own way. The "Self" asserts itself through observational witnessing; the "Me" demands embodiment, affective resonance, and experiential presence; and the "I" insists on narrating, interpreting, and reflecting. From their dynamic alliances, subtle rivalries, and negotiated compromises, the lived *experience of being* continually emerges.

In altered states of consciousness, this balance of power shifts. At times one "ruler" dominates; at other times all three are dethroned. Their usual negotiations give way to new coalitions – fleeting, unstable, and often revelatory. The "Self", once a distant observer, may become an omnipresent witness or fade into the background, leaving perception unanchored. The "Me", typically grounded in bodily and emotional experience, may expand beyond its usual boundaries, dissolve into ecstatic unity, or fracture into unfamiliar sensations. The "I", the narrator, may lose its script, surrendering its role to silence, or become a new voice altogether. Thus, altered states are not merely disruptions – they are "experiments in governance", moments in which the inner world is reimagined and the triumvirate is tested, reconfigured, or transcended.

5.1. Limitations and strengths

While this study offers novel data on the neurophenomenological dynamics of three aspects of Selfhood ("Self", "Me", and "I") during a prolonged ASC induced by breathwork, several limitations should be acknowledged and addressed in future research.

First, the relatively small sample size may limit the reliability of the study's findings. Nevertheless, the findings of this study are consistent with a substantial body of empirical neurophenomenological data on changes in the three aspects of Selfhood during short-term ASCs and across diverse neuropsychopathological conditions (for reviews, see Fingelkurts et al., 2023; Fingelkurts & Fingelkurts, 2025). This convergence with prior evidence strengthens confidence in the present findings. Still, future studies with larger samples are needed to confirm and extend these findings.

Second, the study did not include a placebo control. While placebo controls are essential when the aim is to establish causal conclusions about the effectiveness of a given intervention, the present study did not aim to test the hypothesis that CCB can induce ASC. The capacity of CCB to reliably elicit spontaneous ASCs has already been documented in prior work (see Section 1.2 for references). Our study instead leveraged this established feature of CCB as a methodological tool to investigate how different components of Selfhood dynamically evolve during prolonged ASC. Relatedly, if part of the ASC experience was shaped by participants' expectations, this does not undermine the validity of our findings. The focus of the study was not on the causal mechanisms of induction but on the phenomenological and neural dynamics of Selfhood during prolonged ASC, irrespective of whether the altered state was facilitated by psychological or expectancy-related factors. In fact, expectation effects are themselves part of the broader ecology of ASC induction and thus remain relevant to the neurophenomenological characterization of Selfhood. Finally, while a placebo-controlled design would be necessary in future studies aiming to isolate the specific causal contribution of CCB to ASC induction, the current within-subject comparison between baseline and ASC provides a robust framework for addressing the central research question of this article.

Third, the observed effects may have been amplified due to the recruitment of experienced breathwork practitioners. These self-selected individuals likely had certain expectations – shaped either by their engagement with breathwork or by beliefs prevalent within the breathwork community – which could have influenced their subjective experiences. Consequently, the findings of the present study cannot be directly generalized to the broader population. To mitigate this expectancy bias, future studies should include breathwork-naïve participants, who are less likely to hold preconceived notions about the practice.

Fourth, because the present study relies on the Selfhood Triumvirate model, it is important to clarify the current stage of development of this framework. The model, as applied here, is grounded in a broader empirical literature summarized in Fingelkurts et al. (2020), which reviews multiple independent studies and converging lines of evidence on the phenomenology and neurophysiology of minimal, narrative, and agentive self. The same article also cites independent research demonstrating clear correlations between EEG activity at specific electrode sites and there corresponding brain cortical areas. This wider body of evidence provides the conceptual foundation for the Selfhood Triumvirate model. At the same time, the specific operationalization of the framework (particularly the higher-level OM-to-phenomenology assignments, which synthesize the established cortical–functional mappings of the individual electrode sites forming each OM, and the operational synchrony methodology) has been developed within our research group. Importantly, the operational synchrony methodology underlying these assignments has already been independently replicated in several laboratories (e.g., Allegrini et al., 2010; Li et al., 2018; Iliopoulos & Papasotiriou, 2022), while other groups have implemented it conceptually using different mathematical formalisms (e.g., Tokariev et al., 2012; Jeong et al., 2016; Tagliazucchi et al., 2016), collectively supporting the robustness of the analytic approach itself. Nevertheless, future independent applications of these validated tools specifically to the Selfhood Triumvirate model would further strengthen and refine the framework.

Fifth, the neurophysiological analysis was restricted to the EEG alpha frequency range. Although this choice was thoroughly justified (see section "EEG Registration and Pre-processing"), it is possible that examining other frequency bands could yield different or complementary findings.

Sixth, the study relied on Finnish translations of standardized questionnaires that have not yet undergone formal validation within the local context (the only exception is the Mystical Experience Questionnaire that has been both translated and formally validated for use in a Finnish context (Kangaslampi et al., 2020)). Although a rigorous forward–backward translation procedure was implemented to ensure conceptual and semantic equivalence (Beaton et al., 2000; Gjersing et al., 2010), linguistic and cultural nuances may still influence how participants interpret constructs such as "mindfulness" or "ego." At the same time, these instruments assess phenomenological domains that have shown substantial cross-cultural stability in previous research (Studerus et al., 2010), supporting their expected validity in this context.

Seventh, although the introspective reports enabled us to segment each report into a temporal sequence of phenomenological phases, the psychometric questionnaires employed lacked temporal resolution, instead offering a static characterization of the entire CCB session. This represents a methodological limitation. Future research would benefit from incorporating temporal experience tracing (TET), a technique particularly well-suited to studies of prolonged ASoSs where phenomenological trajectories can vary significantly across individuals. Introduced by Jachs (2021), TET requires participants to retrospectively chart the intensity of their experiences over time across multiple phenomenological dimensions, thereby capturing dynamic shifts in subjective experiences with greater precision.

Eighth, because CCB induced profound alterations in self-experience, including episodes of ego dissolution, participants' ability to accurately recall and temporally locate specific phases of the CCB session may have been affected. Although introspective reports collected immediately after altered-state experiences are generally considered reliable for capturing the broad temporal structure of subjective phenomena (e.g., Berkovich-Ohana et al., 2013; Barrett et al., 2015; Timmermann et al., 2025), some degree of reduced temporal precision cannot be ruled out. This limitation should be taken into account when interpreting the phase-specific phenomenological data.

Ninth, CCB is known to reduce CO_2 levels even with passive exhalation. Because hypocapnia can affect cerebral blood flow and EEG activity, it represents a potential confounding factor. The present study did not include physiological recordings such as respiratory rate, capnography, or blood oxygenation. However, the primary aim of the present study was not to investigate the physiological mechanisms through which CCB induces altered states, but rather to characterize the neurophenomenological dynamics of Selfhood during a prolonged ASC, irrespective of the specific physiological pathway by which the state was initiated. While CO_2 reduction is likely one of the triggers facilitating entry into the altered state, recent work of Havenith et al. (2025) shows that CO_2 levels begin to rise gradually during the second half of a CCB session, approaching baseline. In contrast, our data demonstrate that the profound and phase-specific alterations in both phenomenology and OM-level neural dynamics persist throughout the entire session, including during this period of CO_2 recovery. This temporal dissociation argues against a simple hypocapnic account of the observed effects. It suggests that once neural functioning transitions into an altered operational mode, the initial physiological trigger is not required to sustain the state or to shape its internal dynamics (see also Havenith et al., 2025).

Tenth, the current study utilized group-level analyses, which may obscure idiosyncratic neurophenomenological patterns associated with different components of Selfhood and individuals. Averaging across participants can mask asynchronous or uniquely individualized expressions of Self-related processes, highlighting the need for future work to complement group analysis with idiographic approaches that preserve within-subject variability.

Eleventh, while the study suggests potential benefits of breathwork, possible adverse effects were not systematically assessed. Participants were invited to provide open-ended feedback, and none reported negative outcomes; however, the absence of questions targeting negative effects may have limited their detection. Furthermore, since the sample consisted of experienced breathwork practitioners – who may be more resilient to negative experiences – the incidence of adverse effects in the general population may be underestimated. To ensure a balanced evaluation of breathwork interventions, future more clinically oriented studies should explicitly assess potential negative or aversive outcomes (in this context, see, for example, Katar et al., 2025), thereby enhancing the overall safety profile and applicability of breathwork practices.

Despite these limitations, several key strengths distinguish the present study: (i) the experimental setup closely mirrored commonly practiced breathwork sessions (however, excluding music and group sharing). This allowed us to demonstrate that CCB alone, even in the absence of supportive contextual elements, is sufficient to evoke ASC and ASoS; (ii) hypothesis-driven analysis was informed by the neurophenomenological model of the Selfhood triad, specifically examining how functional connectivity within three SRN OMs maps onto the three phenomenological facets of Selfhood: the "Self," the "Me," and the "I"; (iii) state-of-the-art EEG analysis based on operational synchrony, a technique designed to detect "operational modules", i.e., sets of temporally synchronized neuronal operations generated by spatially distant functional neural assemblies (Fingelkurts & Fingelkurts, 2008, 2015); (iv) adoption of the neurophenomenological design (Gallagher, 2003; Lutz & Thompson, 2003; Fazelpour & Thompson, 2015) enabling comprehensive integration of first-person phenomenological and third-person neurophysiological data within the same study framework.

Author contributions

Andrew A. Fingelkurts: Conceptualization, Methodology, Investigation, Resources, Intervention, Data collection, Data curation, Formal analysis, Writing – Original Draft, Visualization, Project administration. **Alexander A. Fingelkurts:** Conceptualization, Methodology, Investigation, Resources, Formal analysis, Writing – Review & Editing, Visualization. **Tarja Kallio-Tamminen:** Conceptualization, Methodology, Writing – Review & Editing. **Tomi Räisänen:** Recruitment, Intervention, Data collection, Writing – Review & Editing. **Emily Räisänen:** Intervention, Data collection, Writing – Review & Editing.

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Declaration of Conflicting Interests

An.A.F. and Al.A.F. are scientific co-founders of the BM-Science Centre that focuses on fundamental and applied neuroscience research, the development of qEEG-based brain analysis methods, and the creation of well-being applications. An.A.F. and Al.A.F. hold senior researcher positions at BM-Science and are the developers of both the theoretical model of Selfhood and the EEG-based methodology used in this study, which have been previously described in several articles. T.R. and E.R. are co-owners of Breathwork Finland, a company offering training courses and consulting services related to breathing exercises. T.K.-T. has no potential conflicts of interest regarding the research, authorship, or publication of this article.

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Data availability

Individual-level data used in this study cannot be shared due to privacy and ethical restrictions. According to the informed consent approved for this research, participants authorized only the use and publication of group-level aggregated data, which are already fully reported in this article. The consent form did not permit the sharing of raw or anonymized individual data, and retroactive re-consent is not feasible. To support transparency and facilitate future meta-analytic work, the authors intend for the group-mean data from the 11D-ASC and MEQ-30 standardized questionnaires (both of which constitute core outcome measures in this study) to be made publicly available through the Altered States Database (ASDB; https://asdb.info) and OSF (https://osf.io/8mbru). Inclusion in the ASDB occurs during its annual update cycle following full publication of the article (the procedure is carried out by the database curators). The analytic procedure for operational synchrony is described in detail in Kaplan et al. (2005), with broader methodological context provided in Fingelkurts & Fingelkurts (2008, 2015).

References

Aggarwal, R., & Ranganathan, P. (2016). Common pitfalls in statistical analysis: The use of correlation techniques. *Perspectives in Clinical Research, 7*(4), 187–190. https://doi.org/10.4103/2229-3485.192046

Allegrini, P., Paradisi, P., Menicucci, D., & Gemignani, A. (2010). Fractal complexity in spontaneous EEG metastable-state transitions: New vistas on integrated neural dynamics. *Frontiers in Physiology*, 1, 128. https://doi.org/10.3389/fphys.2010.00128

Andrews-Hanna, J. R., Reidler, J. S., Sepulcre, J., Poulin, R., & Buckner, R. L. (2010). Functional-anatomic fractionation of the brain's default network. *Neuron, 65*(4), 550–562. https://doi.org/10.1016/j.neuron.2010.02.005

Andrews-Hanna, J. R., Smallwood, J., & Spreng, R. N. (2014). The default network and self-generated thought: Component processes, dynamic control, and clinical relevance. *Annals of the New York Academy of Sciences, 1316*(1), 29–52. https://doi.org/10.1111/nyas.12360

Apps, M. A., & Tsakiris, M. (2014). The free-energy self: A predictive coding account of self-recognition. *Neuroscience & Biobehavioral Reviews, 41*, 85–97. https://doi.org/10.1016/j.neubiorev.2013.01.029

Asendorf, J. B. (2002). Self-awareness, other-awareness, and secondary representation. In A. Meltzoff & W. Prinz (Eds.), *The imitative mind: Development, evolution, and brain bases* (pp. 63–73). Cambridge, England: Cambridge University Press.

Ataria, Y., Dor-Ziderman, Y., & Berkovich-Ohana, A. (2015). How does it feel to lack a sense of boundaries? A case study of a long-term mindfulness meditator. *Consciousness and Cognition, 37*, 133–147. https://doi.org/10.1016/j.concog.2015.09.002

Aymerich-Franch, L., Petit, D., Ganesh, G., & Kheddar, A. (2015, June 30–July 2). Embodiment of a humanoid robot is preserved during partial and delayed control. In *Proceedings of the IEEE International Workshop on Advanced Robotics and its Social Impacts (ARSO 2015)*, Lyon, France. https://doi.org/10.1109/ARSO.2015.7428218

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27–45. https://doi.org/10.1177/1073191105283504

Bahi, C., Irrmischer, M., Franken, K., Fejer, G., Schlenker, A., Deijen, J. B., & Engelbregt, H. (2024). Effects of conscious connected breathing on cortical brain activity, mood and state of consciousness in healthy adults. *Current Psychology, 43*, 10578–10589. https://doi.org/10.1007/s12144-023-05119-6

Barrett, F. S., & Griffiths, R. R. (2018). Classic hallucinogens and mystical experiences: Phenomenology and neural correlates. *Current Topics in Behavioral Neurosciences, 36*, 393–430. https://doi.org/10.1007/7854_2017_474

Barrett, F. S., Johnson, M. W., & Griffiths, R. R. (2015). Validation of the revised Mystical Experience Questionnaire in experimental sessions with psilocybin. *Journal of Psychopharmacology, 29*(11), 1182–1190. https://doi.org/10.1177/0269881115609019

Başar, E., & Güntekin, B. (2009). Darwin's evolution theory, brain oscillations, and complex brain function in a new "Cartesian view". *International Journal of Psychophysiology, 71*(1), 2–8. https://doi.org/10.1016/j.ijpsycho.2008.07.018

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, *25*(24), 3186-91. https://doi.org/10.1097/00007632-200012150-00014

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*(6), 561–571. https://doi.org/10.1001/archpsyc.1961.01710120031004

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B (Methodological)*, *57*(1), 289–300. http://www.jstor.org/stable/2346101

Benjamini, Y., & Yekutieli, D. (2001). The control of the false discovery rate in multiple testing under dependency. *The Annals of Statistics*, *29*(4), 1165–1188. http://www.jstor.org/stable/2674075

Benninger, C., Matthis, P., & Scheffner, D. (1984). EEG development of healthy boys and girls: Results of a longitudinal study. *Electroencephalography and Clinical Neurophysiology, 57*(1), 1–12. https://doi.org/10.1016/0013-4694(84)90002-6

Berkovich-Ohana, A., Dor-Ziderman, Y., Glicksohn, J., & Goldstein, A. (2013). Alterations in the sense of time, space and body in the mindfulness-trained brain: A neurophenomenologically-guided MEG study. *Frontiers in Psychology, 4*, Article 912. https://doi.org/10.3389/fpsyg.2013.00912

Blanke, O., & Metzinger, T. (2009). Full-body illusions and minimal phenomenal selfhood. *Trends in Cognitive Sciences, 13*(1), 7–13. https://doi.org/10.1016/j.tics.2008.10.003

Blumenfeld, H. (2012). Impaired consciousness in epilepsy. *The Lancet Neurology, 11*(9), 814–826. https://doi.org/10.1016/S1474-4422(12)70188-6

Bodmer, I., Dittrich, A., & Lamparter, D. (1994). Aussergewöhnliche Bewusstseinszustände – Ihre gemeinsame Struktur und Messung [Altered states of consciousness – Their common structure and assessment]. In A. Dittrich, A. Hofmann, & H. Leuner (Eds.), *Welten des Bewusstseins: Bd. 3. Experimentelle Psychologie, Neurobiologie und Chemie* (pp. 45–58). VWB – Verlag für Wissenschaft und Bildung.

Cardeña, E., & Winkelman, M. (2011). *Altering consciousness: Multidisciplinary perspectives: History, culture, and the humanities; Biological and psychological perspectives*. Praeger/ABC-CLIO.

Cardeña, E., Lynn, S. J., & Krippner, S. (Eds.). (2014). *Varieties of anomalous experience: Examining the scientific evidence* (2nd ed.). Washington, DC: American Psychological Association.

Cardeña, E., Berkovich-Ohana, A., Valli, K., Barttfeld, P., Gomez-Marin, A., Greyson, B., Kumar, V. K., Laureys, S., Luhrmann, T. M., Newberg, A., Preller, K. H., Putnam, F. W., Tagliazucchi, E., Walsh, R., Carter, O., & Yaden, D. (2025). A consensus taxonomy of altered (nonordinary) states of consciousness: Bringing order to disarray. *Psychology of Consciousness: Theory, Research, and Practice*. Advance online publication. https://doi.org/10.1037/cns0000431

Carhart-Harris, R. L., Leech, R., Hellyer, P. J., Shanahan, M., Feilding, A., Tagliazucchi, E., Chialvo, D. R., & Nutt, D. J. (2014). The entropic brain: A theory of conscious states informed by neuroimaging research with psychedelic drugs. *Frontiers in Human Neuroscience, 8*, 20. https://doi.org/10.3389/fnhum.2014.00020

Carhart-Harris, R. L., Bolstridge, M., Day, C. M. J., Rucker, J., Watts, R., Erritzoe, D. E., Kaelen, M., Giribaldi, B., Bloomfield, M., Pilling, S., Rickard, J. A., Forbes, B., Feilding, A., Taylor, D., Curran, H. V., & Nutt, D. J. (2018). Psilocybin with psychological support for treatment-resistant depression: Six-month follow-up. *Psychopharmacology, 235*(2), 399–408. https://doi.org/10.1007/s00213-017-4771-x

Carr, E. (2014). *Rebirthing: The transformation of personhood through embodiment and emotion* (Doctoral thesis). The University of Adelaide, Adelaide, Australia.

Chiong, W. (2011). The self: From philosophy to cognitive neuroscience. *Neurocase, 17*(3), 190–200. https://doi.org/10.1080/13554794.2010.532808

Chowdhury, A., van Lutterveld, R., Laukkonen, R. E., Slagter, H. A., Ingram, D. M., & Sacchet, M. D. (2023). Investigation of advanced mindfulness meditation “cessation” experiences using EEG spectral analysis in an intensively sampled case study. *Neuropsychologia, 190*, Article 108694. https://doi.org/10.1016/j.neuropsychologia.2023.108694

Christoff, K., Cosmelli, D., Legrand, D., & Thompson, E. (2011). Specifying the self for cognitive neuroscience. *Trends in Cognitive Sciences*, *15*(3), 104–112. https://doi.org/10.1016/j.tics.2011.01.001

Churchland, P. S. (2003). Self-representation in nervous systems. *Annals of the New York Academy of Sciences, 1001*, 31–38. https://doi.org/10.1196/annals.1279.002

Ciaunica, A., Charlton, J., & Farmer, H. (2021). When the window cracks: Transparency and the fractured self in depersonalisation. *Phenomenology and the Cognitive Sciences, 20*(1), 1–19. https://doi.org/10.1007/s11097-020-09677-z

Corneille, O., & Gawronski, B. (2024). Self-reports are better measurement instruments than implicit measures. *Nature Reviews Psychology, 3*, 835–846. https://doi.org/10.1038/s44159-024-00376-z

Damasio, A. R. (1999). *The feeling of what happens: Body and emotion in the making of consciousness*. San Diego, CA: Harcourt Brace.

Damasio, A. R. (2010). *When self comes to mind*. New York, NY: Pantheon Books.

Dankel, S. J., Mouser, J. G., Mattocks, K. T., Counts, B. R., Jessee, M. B., Buckner, S. L., Loprinzi, P. D., & Loenneke, J. P. (2017). The widespread misuse of effect sizes. *Journal of Science and Medicine in Sport*, *20*(5), 446-450. https://doi.org/10.1016/j.jsams.2016.10.003

Davey, C. G., Pujol, J., & Harrison, B. J. (2016). Mapping the self in the brain's default mode network. *NeuroImage, 132*, 390–397. https://doi.org/10.1016/j.neuroimage.2016.02.022

De Wit, P. A. J. M., & Moraes Cruz, R. M. (2021). Treating PTSD with connected breathing: A clinical case study and theoretical implications. *European Journal of Trauma & Dissociation, 5*(3), 100152. https://doi.org/10.1016/j.ejtd.2020.100152

De Wit, P. A. J. M., Menezes, C. B., Dias de Oliveira, C. A., Vieira da Luz Costa, R., & Moraes Cruz, R. (2018). Rebirthing-breathwork, activation of the autonomic nervous system, and psychophysiological defences. *Revista Brasileira de Psicoterapia, 20*(2), 29–42.

Dittrich, A. (1998). The standardized psychometric assessment of altered states of consciousness (ASCs) in humans. *Pharmacopsychiatry, 31*(Suppl 2), 80–84. https://doi.org/10.1055/s-2007-979351

Dor-Ziderman, Y., Ataria, Y., Fulder, S., Goldstein, A., & Berkovich-Ohana, A. (2016). Self-specific processing in the meditating brain: A MEG neurophenomenology study. *Neuroscience of Consciousness, 2016*(1), Article niw019. https://doi.org/10.1093/nc/niw019

Dowling, C., (2000). *Rebirthing and breathwork: A powerful technique for personal transformation*. London: Piatkus.

Efron, B. (2010). *Large-scale inference: Empirical bayes methods for estimation, testing, and prediction*. Cambridge: Cambridge University Press.

Ehmann, S., Sezer, I., Treves, I. N., Gabrieli, J. D. E., & Sacchet, M. D. (2025a). Mindfulness, cognition, and long-term meditators: Toward a science of advanced meditation. *Imaging Neuroscience*, *3*, Article IMAG.a.82. https://doi.org/10.1162/IMAG.a.82

Ehmann, S., Lord, B., Cook, E., Brookman, H. B., Roces, J., Peck, T., Young, S., Sacchet, M., Allen, J. J., & Sanguinetti, J. L. (2025b) Enhancing meditative development with transcranial focused ultrasound: A mixed-methods phenomenological study of neuromodulation in experienced meditators during a ten-day retreat. PsyArXiv, October 8. doi:10.31234/osf.io/uxrwy_v2

Ehmann, S., Pohlig, R. T., Chaoul, A., Cuzzupe, J., Vaughn, M., Rocco, G., Wangyal, T., & Gawrysiak, M. (2025c). Bridging the soteriological-secular divide: A 9-month online Tibetan mind-body practice program enhances eudaimonic well-being and non-dual awareness. *Mindfulness*. https://doi.org/10.1007/s12671-025-02704-7

Ehrmann, W. (2001). Breath is your companion. In G. Minett (Ed.), *The spirit of breathwork* (pp. 199–208). Cambridge: The International Breathwork Foundation.

Fair, D. A., Cohen, A. L., Dosenbach, N. U., Church, J. A., Miezin, F. M., Barch, D. M., Raichle, M. E., Petersen, S. E., & Schlaggar, B. L. (2008). The maturing architecture of the brain's default network. *Proceedings of the National Academy of Sciences, 105*(10), 4028–4032. https://doi.org/10.1073/pnas.0800376105

Farhi, D. (1996). *The breathing book: Good health and vitality through essential breath work*. New York, NY: Henry Holt and Company.

Fazelpour, S., & Thompson, E. (2015). The Kantian brain: Brain dynamics from a neurophenomenological perspective. *Current Opinion in Neurobiology, 31*, 223–229. https://doi.org/10.1016/j.conb.2014.12.006

Fincham, G. W., Kartar, A., Uthaug, M. V., Anderson, B., Hall, L., Nagai, Y., Critchley, H., & Colasanti, A. (2023). High ventilation breathwork practices: An overview of their effects, mechanisms, and considerations for clinical applications. *Neuroscience & Biobehavioral Reviews, 155*, 105453. https://doi.org/10.1016/j.neubiorev.2023.105453

Fingelkurts, A. A., & Fingelkurts, A. A. (2008). Brain-mind operational architectonics imaging: Technical and methodological aspects. *Open Neuroimaging Journal, 2*, 73–93. https://doi.org/10.2174/1874440000802010073

Fingelkurts, A. A., & Fingelkurts, A. A. (2010). Short-term EEG spectral pattern as a single event in EEG phenomenology. *Open Neuroimaging Journal, 4*, 130–156. https://doi.org/10.2174/1874440001004010130

Fingelkurts, A. A., & Fingelkurts, A. A. (2011). Persistent operational synchrony within brain default-mode network and self-processing operations in healthy subjects. *Brain and Cognition, 75*(2), 79–90. https://doi.org/10.1016/j.bandc.2010.11.015

Fingelkurts, A. A., & Fingelkurts, A. A. (2014). EEG oscillatory states: Universality, uniqueness and specificity across healthy-normal, altered and pathological brain conditions. *PLoS ONE, 9*(2), e87507. https://doi.org/10.1371/journal.pone.0087507

Fingelkurts, A. A., & Fingelkurts, A. A. (2015). Operational architectonics methodology for EEG analysis: Theory and results. In V. Sakkalis (Ed.), *Modern Electroencephalographic Assessment Techniques* (Vol. 91, pp. 1–59). New York, NY: Humana Press. https://doi.org/10.1007/7657_2013_60

Fingelkurts, A. A., & Fingelkurts, A. A. (2017a). Three-dimensional components of selfhood in treatment-naive patients with major depressive disorder: A resting-state qEEG imaging study. *Neuropsychologia, 99*, 30–36. https://doi.org/10.1016/j.neuropsychologia.2017.02.020

Fingelkurts, A. A., & Fingelkurts, A. A. (2017b). Longitudinal dynamics of 3-dimensional components of selfhood after severe traumatic brain injury: A qEEG case study. *Clinical EEG and Neuroscience, 48*(5), 327–337. https://doi.org/10.1177/1550059417696180

Fingelkurts, A. A., & Fingelkurts, A. A. (2018). Alterations in the three components of selfhood in persons with post-traumatic stress disorder symptoms: A pilot qEEG neuroimaging study. *The Open Neuroimaging Journal, 12*, 42–54. https://doi.org/10.2174/1874440001812010042

Fingelkurts, A. A., & Fingelkurts, A. A. (2022). Depersonalization puzzle: A new view from the neurophenomenological selfhood perspective. *Journal of NeuroPhilosophy, 1*(2), 181–202. https://doi.org/10.5281/zenodo.7253994

Fingelkurts, A. A., & Fingelkurts, A. A. (2023). Patients with disorders of consciousness: Are they nonconscious, unconscious, or subconscious? Expanding the discussion. *Brain Sciences, 13*, Article 814. https://doi.org/10.3390/brainsci13050814

Fingelkurts, A. A., & Fingelkurts, A. A. (2025). Self, Me, or I? Unravelling the triumvirate of selfhood in pathological consciousness. *Brain Sciences, 15*(6), Article 640. https://doi.org/10.3390/brainsci15060640

Fingelkurts, A. A., & Fingelkurts, A. A. (2026). Trait-like stability of selfhood triumvirate and its constituent aspects: A qEEG intra-individual test–retest reliability study. *Consciousness and Cognition*, *139*, Article 104004. https://doi.org/10.1016/j.concog.2026.104004

Fingelkurts, A. A., & Fingelkurts, A. A. Neves, C. F. H. (2010). Natural world physical, brain operational, and mind phenomenal space-time. *Physics of Life Reviews, 7*(2), 195–249. https://doi.org/10.1016/j.plrev.2010.04.001

Fingelkurts, A. A., Fingelkurts, A. A., & Neves, C. F. H. (2013). Consciousness as a phenomenon in the operational architectonics of brain organization: Criticality and self-organization considerations. *Chaos, Solitons & Fractals, 55*, 13–31. https://doi.org/10.1016/j.chaos.2013.02.007

Fingelkurts, A. A., & Fingelkurts, A. A., & Kallio-Tamminen, T. (2016a). Long-term meditation training induced changes in the operational synchrony of default mode network modules during a resting state. *Cognitive Processing, 17*(1), 27–37. https://doi.org/10.1007/s10339-015-0743-4

Fingelkurts, A. A., Fingelkurts, A. A., & Kallio-Tamminen, T. (2016b). Trait lasting alteration of the brain default mode network in experienced meditators and the experiential selfhood. *Self and Identity, 15*(4), 381–393. https://doi.org/10.1080/15298868.2015.1136351

Fingelkurts, A. A., Fingelkurts, A. A., & Kallio-Tamminen, T. (2020). Selfhood triumvirate: From phenomenology to brain activity and back again. *Consciousness and Cognition, 86*, Article 103031. https://doi.org/10.1016/j.concog.2020.103031

Fingelkurts, A., Fingelkurts, A., & Kallio-Tamminen, T. (2022). Self, Me and I in the repertoire of spontaneously occurring altered states of selfhood: Eight neurophenomenological case study reports. *Cognitive Neurodynamics, 16*(2), 255–282. https://doi.org/10.1007/s11571-021-09719-5

Fingelkurts, A., Fingelkurts, A., & Kallio-Tamminen, T. (2023). The selfhood-components dynamics in the spectrum of discrete normotypical and pathological modes. *Journal of NeuroPhilosophy, 2*(2). https://doi.org/10.5281/zenodo.10203089

Fingelkurts, A. A., Fingelkurts, A. A., & Bagnato, S., Boccagni, C., & Galardi, G. (2012). DMN operational synchrony relates to self-consciousness: Evidence from patients in vegetative and minimally conscious states. *Open Neuroimaging Journal, 6*, 55–68. https://doi.org/10.2174/1874440001206010055

Fingelkurts, A. A., Fingelkurts, A. A., Bagnato, S., Boccagni, C., & Galardi, G. (2016c). The chief role of frontal operational module of the brain default mode network in the potential recovery of consciousness from the vegetative state: A preliminary comparison of three case reports. *Open Neuroimaging Journal, 10*, 41–51. https://doi.org/10.2174/1874440001610010041

Fischer, R., Bortolini, G., Bortolini, T., Maraldi, E., Hartle, L., de Lima Varejao, M. V., et al. (2025). Revisiting the unusual: Investigating the prevalence and validity of nonordinary experiences as a window into consciousness (Version 1) [Preprint]. *Research Square*. https://doi.org/10.21203/rs.3.rs-6907742/v1

Fort, L. D., Costines, C., Wittmann, M., Demertzi, A., & Schmidt, T. T. (2025). Classification schemes of altered states of consciousness. *Neuroscience & Biobehavioral Reviews, 175*, Article 106178. https://doi.org/10.1016/j.neubiorev.2025.106178

Fox, K. C., Spreng, R. N., Ellamil, M., Andrews-Hanna, J. R., & Christoff, K. (2015). The wandering brain: Meta-analysis of functional neuroimaging studies of mind-wandering and related spontaneous thought processes. *NeuroImage, 111*, 611–621. https://doi.org/10.1016/j.neuroimage.2015.02.039

Freeman, W., & Kozma, R. (2000). Local-global interactions and the role of mesoscopic (intermediate-range) elements in brain dynamics. *Behavioral and Brain Sciences, 23*(3), Article 401. https://doi.org/10.1017/S0140525X00243252

Freeman, W. J., Kozma, R., Li, G., Quiroga, R. Q., Vitiello, G., & Zhang, T. (2015). Advanced models of cortical dynamics in perception. In H. Liljenström (Ed.), *Advances in Cognitive Neurodynamics (IV)* (pp. 127–136). Dordrecht: Springer. https://doi.org/10.1007/978-94-017-9548-7_17

Frith, C. D., & Metzinger, T. (2016). What's the use of consciousness? How the stab of conscience made us really conscious. In A. K. Engel, K. J. Friston, & D. Kragic (Eds.), *The pragmatic turn: Toward action-oriented views in cognitive science* (pp. 193–214). Cambridge, MA: MIT Press.

Gallagher, S. (2000). Philosophical conceptions of the self: Implications for cognitive science. *Trends in Cognitive Sciences, 4*(1), 14–21. https://doi.org/10.1016/S1364-6613(99)01417-5

Gallagher, S. (2003). Phenomenology and experimental design. *Journal of Consciousness Studies, 10*(9–10), 85–99.

Gallagher, S. (2013). A pattern theory of self. *Frontiers in Human Neuroscience, 7*, Article 443. https://doi.org/10.3389/fnhum.2013.00443

Gallagher, S., & Daly, A. (2018). Dynamical relations in the self-pattern. *Frontiers in Psychology, 9*, Article 664. https://doi.org/10.3389/fpsyg.2018.00664

Gallagher, S., & Sørensen, J. B. (2006). Experimenting with phenomenology. *Consciousness and Cognition, 15*(1), 119–134. https://doi.org/10.1016/j.concog.2005.03.002

Gallagher, S., & Zahavi, D. (2012). *The phenomenological mind: An introduction to philosophy of mind and cognitive science* (2nd ed.). London: Routledge.

Gallagher, S., & Zahavi, D. (2015). Phenomenological approaches to self-consciousness. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Spring Edition). http://plato.stanford.edu/archives/spr2015/entries/self-consciousness-phenomenological/

García-Pérez, M. A. (2023). Use and misuse of corrections for multiple testing. *Methods in Psychology, 8*, Article 100120. https://doi.org/10.1016/j.metip.2023.100120

Gasser, T., Verleger, R., Bächer, P., & Sroka, L. (1988). Development of the EEG of school-age children and adolescents. I. Analysis of band power. *Electroencephalography and Clinical Neurophysiology, 69*(2), 91–99. https://doi.org/10.1016/0013-4694(88)90204-0

Gjersing, L., Caplehorn, J. R., & Clausen, T. (2010). Cross-cultural adaptation of research instruments: language, setting, time and statistical considerations. *BMC Medical Research Methodology*, *10*, Article 13. https://doi.org/10.1186/1471-2288-10-13.

Glicksohn, J., & Ben-Soussan, T. D. (2020). Immersion, absorption, and spiritual experience: Some preliminary findings. *Frontiers in Psychology, 11*, Article 2118. https://doi.org/10.3389/fpsyg.2020.02118

Gopnik, A., & Slaughter, V. (1991). Young children's understanding of changes in their mental states. *Child Development, 62*(1), 98–110. https://doi.org/10.2307/1130707

Griffiths, R. R., Johnson, M. W., Richards, W. A., Richards, B. D., McCann, U., & Jesse, R. (2011). Psilocybin occasioned mystical-type experiences: Immediate and persisting dose-related effects. *Psychopharmacology, 218*, 649–665. https://doi.org/10.1007/s00213-011-2358-5

Griffiths, R. R., Johnson, M. W., Richards, W. A., Richards, B. D., Jesse, R., MacLean, K. A., ... Klinedinst, M. A. (2018). Psilocybin-occasioned mystical-type experience in combination with meditation and other spiritual practices produces enduring positive changes in psychological functioning and in trait measures of prosocial attitudes and behaviors. *Journal of Psychopharmacology, 32*(1), 49–69. https://doi.org/10.1177/0269881117731279

Grof, S. (1993). *The holotropic mind: The three levels of human consciousness and how they shape our lives*. New York, NY: HarperCollins Publishers.

Grof, S. (2019). *The way of the psychonaut Vol. 1: Encyclopedia for inner journeys*. Multidisciplinary Association for Psychedelic Studies.

Gutfreund, M. R. (2009). *The conceptualization and integration of conscious breathing into clinical practice* (Master's thesis). Smith College, Northampton, MA.

Haanila, H. (2021). The dream self and the waking self. In I. Koskinen & T. Toppinen (Eds.), *Reasons and responsibilities: Proceedings of the Philosophical Society of Finland Colloquium* (Vol. 97, pp. 79–103). Helsinki: Acta Philosophica Fennica.

Hamilton, M. (1959). The assessment of anxiety states by rating. *British Journal of Medical Psychology, 32*(1), 50–55. https://doi.org/10.1111/j.2044-8341.1959.tb00467.x

Hartogsohn, I. (2016). Set and setting, psychedelics and the placebo response: An extra-pharmacological perspective on psychopharmacology. *Journal of Psychopharmacology, 30*(12), 1259–1267. https://doi.org/10.1177/0269881116677852

Havenith, M. N., Leidenberger, M., Brasanac, J., et al. (2025). Decreased CO_2 saturation during circular breathwork supports emergence of altered states of consciousness. *Communications Psychology, 3*, Article 59. https://doi.org/10.1038/s44271-025-00247-0

Hick, J. (1962). The teachings of the mystics: Being selections from the great mystics and mystical writings of the world. *Journal of Philosophy, 59*(5), 135–136. https://doi.org/10.2307/2023306

Hirschfeld, T., & Schmidt, T. T. (2021). Dose-response relationships of psilocybin-induced subjective experiences in humans. *Journal of Psychopharmacology, 35*(4), 384–397. https://doi.org/10.1177/0269881121992676

Hohwy, J. (2007). The sense of self in the phenomenology of agency and perception. *Psyche, 13*, 1–20. https://journalpsyche.org/files/0xab11.pdf

Iliopoulos, A. C., & Papasotiriou, I. (2022). Functional complex networks based on Operational Architectonics: Application on EEG-based brain–computer interface for imagined speech. Neuroscience, 484, 98-118. https://doi.org/10.1016/j.neuroscience.2021.11.045

Iyengar, B. K. S. (1988). *Light on yoga: Yoga dipika*. London: Unwin Hyman.

Jack, A. I., & Roepstorff, A. (2002). Introspection and cognitive brain mapping: From stimulus-response to script-report. *Trends in Cognitive Sciences, 6*(8), 333–339. https://doi.org/10.1016/s1364-6613(02)01941-1

Jachs, B. (2021). *The neurophenomenology of meditative states: Introducing temporal experience tracing to capture subjective experience states and their neural correlates* (Doctoral thesis). University of Cambridge, UK.

Jann, K., Dierks, T., Boesch, C., Kottlow, M., Strik, W., & Koenig, T. (2009). BOLD correlates of EEG alpha phase-locking and the fMRI default mode network. *NeuroImage, 45*(3), 903–916. https://doi.org/10.1016/j.neuroimage.2009.01.001

James, E., Robertshaw, T. L., Hoskins, M., & Sessa, B. (2020). Psilocybin occasioned mystical-type experiences. *Human Psychopharmacology: Clinical and Experimental, 35*(5), Article e2742. https://doi.org/10.1002/hup.2742

James, W. (1890). The principles of psychology. New York: Henry Holt and Company.

Jeong, S.-O., Pae, C., & Park, H.-J. (2016). Connectivity-based change point detection for large-size functional networks. *NeuroImage*, *143*, 353-363. http://dx.doi.org/10.1016/j.neuroimage.2016.09.019

Josipovic, Z. (2010). Duality and nonduality in meditation research. *Consciousness and Cognition, 19*(4), 1119–1121. https://doi.org/10.1016/j.concog.2010.03.016

Josipovic, Z. (2019). Nondual awareness: Consciousness-as-such as non-representational reflexivity. *Progress in Brain Research*, *244*, 273–298. https://doi.org/10.1016/bs.pbr.2018.10.021

Josipovic, Z., & Miskovic, V. (2020). Nondual awareness and minimal phenomenal experience. *Frontiers in Psychology, 11*, Article 2087. https://doi.org/10.3389/fpsyg.2020.02087

Kaplan, A. Y., Fingelkurts, A. A., Fingelkurts, A. A., Borisov, S. V., & Darkhovsky, B. S. (2005). Nonstationary nature of the brain activity as revealed by EEG/MEG: Methodological, practical and conceptual challenges. *Signal Processing*, *85*, 2190-2212. https://doi.org/10.1016/j.sigpro.2005.07.010

Kallio, S., & Revonsuo, A. (2003). Hypnotic phenomena and altered states of consciousness: A multilevel framework of description and explanation. *Contemporary Hypnosis, 20*(3), 111–164. https://doi.org/10.1002/ch.273

Kangaslampi, S., Hausen, A., Rauteenmaa, T. (2020). Mystical experiences in retrospective reports of first times using a psychedelic in Finland. *Journal of Psychoactive Drugs*. *52*(4), 309-318. https://doi.org/10.1080/02791072.2020.1767321.

Kartar, A. A., Horinouchi, T., Örzsik, B., Anderson, B., Hall, L., Bailey, D., et al. (2025). Neurobiological substrates of altered states of consciousness induced by high ventilation breathwork accompanied by music. *PLoS ONE, 20*(8), e0329411. https://doi.org/10.1371/journal.pone.0329411

Kim, H. (2012). A dual-subsystem model of the brain's default network: Self-referential processing, memory retrieval processes, and autobiographical memory retrieval. *NeuroImage, 61*(4), 966–977. https://doi.org/10.1016/j.neuroimage.2012.03.025

Kirmayer, L. J., & Crafa, D. (2014). What kind of science for psychiatry? *Frontiers in Human Neuroscience, 8*, Article 435. https://doi.org/10.3389/fnhum.2014.00435

Klein, S. B. (2016). Autonoetic consciousness: Reconsidering the role of episodic memory in future-oriented self-projection. *Quarterly Journal of Experimental Psychology, 69*(2), 381–401. https://doi.org/10.1080/17470218.2015.1007150

Klimesch, W., Sauseng, P., & Hanslmayr, S. (2007). EEG alpha oscillations: The inhibition-timing hypothesis. *Brain Research Reviews, 53*(1), 63–88. https://doi.org/10.1016/j.brainresrev.2006.06.003

Knyazev, G. G., Savostyanov, A. N., Volf, N. V., Liou, M., & Bocharov, A. V. (2012). EEG correlates of spontaneous self-referential thoughts: A cross-cultural study. *International Journal of Psychophysiology, 86*(2), 173–181. https://doi.org/10.1016/j.ijpsycho.2012.09.002

Knyazev, G. G., Slobodskoj-Plusnin, J. Y., Bocharov, A. V., & Pylkova, L. V. (2011). The default mode network and EEG α oscillations: An independent component analysis. *Brain Research, 1402*, 67–79. https://doi.org/10.1016/j.brainres.2011.05.052

Koessler, L., Maillard, L., Benhadid, A., Vignal, J. P., Felblinger, J., Vespignani, H., & Braun, M. (2009). Automated cortical projection of EEG sensors: Anatomical correlation via the international 10-10 system. *NeuroImage, 46*(1), 64–72. https://doi.org/10.1016/j.neuroimage.2009.02.006

Kozma, R., & Freeman, W. J. (2009). The KIV model of intentional dynamics and decision making. *Neural Networks, 22*(3), 277–285. https://doi.org/10.1016/j.neunet.2009.03.019

Lalande, L., Bambling, M., King, R., & Lowe, R. (2012). Breathwork: An additional treatment option for depression and anxiety? *Journal of Contemporary Psychotherapy, 42*(2), 113–119. https://doi.org/10.1007/s10879-011-9180-6

Landolt, H. P., Retey, J. V., Tonz, K., Gottselig, J. M., Khatami, R., Buckelmuller, I., & Achermann, P. (2004). Caffeine attenuates waking and sleep electroencephalographic markers of sleep homeostasis in humans. *Neuropsychopharmacology, 29*, 1933–1939. https://doi.org/10.1038/sj.npp.1300526

Laufs, H., Kleinschmidt, A., Beyerle, A., Eger, E., Salek-Haddadi, A., Preibisch, C., & Krakow, K. (2003). EEG-correlated fMRI of human alpha activity. *NeuroImage, 19*(4), 1463–1476. https://doi.org/10.1016/s1053-8119(03)00286-6

Legrand, D., & Ruby, P. (2009). What is self-specific? Theoretical investigation and critical review of neuroimaging results. *Psychological Review, 116*(1), 252–282. https://doi.org/10.1037/a0014172

Lewis-Healey, E., Tagliazucchi, E., Canales-Johnson, A., & Bekinschtein, T. A. (2024). Breathwork-induced psychedelic experiences modulate neural dynamics. *Cerebral Cortex, 34*(8), Article bhae347. https://doi.org/10.1093/cercor/bhae347

Li, Z., Kerick, S., Robucci, R., Brooks, J., Garcia, J., & Banerjee, N. (2018). Implementation of structural synchrony and linear measures of brain network connectivity for real-time state estimation. *IEEE International Symposium on Circuits and Systems (ISCAS)*, Florence, Italy, 2018, pp. 1-5, https://doi.org/10.1109/ISCAS.2018.8351019

Limanowski, J., & Blankenburg, F. (2013). Minimal self-models and the free energy principle. *Frontiers in Human Neuroscience, 7*, Article 547. https://doi.org/10.3389/fnhum.2013.00547

Lutz, A., & Thompson, E. (2003). Neurophenomenology. *Journal of Consciousness Studies, 10*, 31–52.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*(4), 163–169. https://doi.org/10.1016/j.tics.2008.01.005

Madsen, M. K., Fisher, P. M., Burmester, D., Dyssegaard, A., Stenbæk, D. S., Kristiansen, S., Johansen, S. S., Lehel, S., Linnet, K., Svarer, C., Erritzoe, D., Ozenne, B., & Knudsen, G. M. (2019). Psychedelic effects of psilocybin correlate with serotonin 2A receptor occupancy and plasma psilocin levels. *Neuropsychopharmacology, 44*(7), 1328–1334. https://doi.org/10.1038/s41386-019-0324-9

Mantini, D., Perrucci, M. G., Del Gratta, C., Romani, G. L., & Corbetta, M. (2007). Electrophysiological signatures of resting state networks in the human brain. *Proceedings of the National Academy of Sciences, 104*(32), 13170–13175. https://doi.org/10.1073/pnas.0700668104

Marino, M., Arcara, G., Porcaro, C., & Mantini, D. (2019). Hemodynamic correlates of electrophysiological activity in the default mode network. *Frontiers in Neuroscience, 13*, 1060. https://doi.org/10.3389/fnins.2019.01060

Matousek, M., & Petersen, I. (1973). Frequency analysis of the EEG in normal children and adolescents. In P. Kellaway & I. Petersen (Eds.), *Automation of clinical electroencephalography* (pp. 75–102). New York: Raven Press.

Metzinger, T. (2003). *Being no one: The self-model theory of subjectivity*. Cambridge, MA: MIT Press.

Metzinger, T. (2013). Why are dreams interesting for philosophers? The example of minimal phenomenal selfhood, plus an agenda for future research. *Frontiers in Psychology, 4*, 746. https://doi.org/10.3389/fpsyg.2013.00746

Metzinger, T. (2020). Minimal phenomenal experience: Meditation, tonic alertness, and the phenomenology of "pure" consciousness. *Philosophy and the Mind Sciences, 1*(I), Article 7. https://doi.org/10.33735/phimisci.2020.I.46

Millière, R. (2017). Looking for the self: Phenomenology, neurophysiology and philosophical significance of drug-induced ego dissolution. *Frontiers in Human Neuroscience, 11*, Article 245. https://doi.org/10.3389/fnhum.2017.00245

Millière, R. (2020). The varieties of selflessness. *Philosophy and the Mind Sciences, 1*(I), 1–41. https://doi.org/10.33735/phimisci.2020.I.48

Millière, R., Carhart-Harris, R. L., Roseman, L., Trautwein, F. M., & Berkovich-Ohana, A. (2018). Psychedelics, meditation, and self-consciousness. *Frontiers in Psychology, 9*, Article 1475. https://doi.org/10.3389/fpsyg.2018.01475

Molnar-Szakacs, I., & Uddin, L. Q. (2013). Self-processing and the default mode network: Interactions with the mirror neuron system. *Frontiers in Human Neuroscience, 7*, Article 571. https://doi.org/10.3389/fnhum.2013.00571

Musholt, K. (2015). *Thinking about oneself: From nonconceptual content to the concept of a self.* Cambridge: MIT Press.

Northoff, G. (2014). *Minding the brain: A guide to philosophy and neuroscience*. London: Palgrave Macmillan.

Northoff, G. (2016). Is the self a higher-order or fundamental function of the brain? The "basis model of self-specificity" and its encoding by the brain's spontaneous activity. *Cognitive Neuroscience, 7*(1–4), 203–222. https://doi.org/10.1080/17588928.2015.1111868

Nour, M. M., & Carhart-Harris, R. L. (2017). Psychedelics and the science of self-experience. *British Journal of Psychiatry, 210*(3), 177–179. https://doi.org/10.1192/bjp.bp.116.194738

Nour, M. M., Evans, L., Nutt, D., & Carhart-Harris, R. L. (2016). Ego-dissolution and psychedelics: Validation of the Ego-Dissolution Inventory (EDI). *Frontiers in Human Neuroscience, 10*, Article 269. https://doi.org/10.3389/fnhum.2016.00269

Orr, L., & Ray, S. (1977). *Rebirthing in the New Age*. Berkley, CA: Celestial Arts.

Pahnke, W. N. (1963). *Drugs and mysticism: An analysis of the relationship between psychedelic drugs and the mystical consciousness* (Doctoral dissertation). Harvard University.

Palva, S., & Palva, J. M. (2007). New vistas for alpha-frequency band oscillations. *Trends in Neurosciences, 30*(4), 150–158. https://doi.org/10.1016/j.tins.2007.02.001

Panksepp, J., & Northoff, G. (2009). The trans-species core SELF: The emergence of active cultural and neuro-ecological agents through self-related processing within subcortical-cortical midline networks. *Consciousness and Cognition, 18*(1), 193–215. https://doi.org/10.1016/j.concog.2008.03.002

Perneger, T. V. (1998). What's wrong with Bonferroni adjustments. *BMJ, 316*, 1236–1238. https://doi.org/10.1136/bmj.316.7139.1236

Polito, V., Barnier, A. J., & Woody, E. Z. (2013). Developing the Sense of Agency Rating Scale (SOARS): An empirical measure of agency disruption in hypnosis. *Consciousness and Cognition, 22*(3), 684–696. https://doi.org/10.1016/j.concog.2013.04.003

Pope, K. S., & Singer, J. L. (Eds.). (1978). *The stream of consciousness*. New York: Plenum.

Povinelli, D. J., Landau, K. R., & Perilloux, H. K. (1996). Self-recognition in young children using delayed versus live feedback: Evidence of a developmental asynchrony. *Child Development, 67*(4), 1540–1554. https://doi.org/10.2307/1131717

Praetorius, N. (2009). The phenomenological underpinning of the notion of a minimal core self: A psychological perspective. *Consciousness and Cognition, 18*(1), 325–338. https://doi.org/10.1016/j.concog.2008.03.005

Preller, K. H., & Vollenweider, F. X. (2018). Phenomenology, structure, and dynamic of psychedelic states. *Current Topics in Behavioral Neurosciences, 36*, 221–256. https://doi.org/10.1007/7854_2016_459

Prugger, J., Derdiyok, E., Dinkelacker, J., Costines, C., & Schmidt, T. T. (2022). The altered states database: Psychometric data from a systematic literature review. *Scientific Data, 9*(1), Article 720. https://doi.org/10.1038/s41597-022-01822-4

Raison, C. L., Sanacora, G., Woolley, J., Heinzerling, K., Dunlop, B. W., Brown, R. T., … Griffiths, R. R. (2023). Single-dose psilocybin treatment for major depressive disorder: A randomized clinical trial. *JAMA, 330*(9), 843–853. https://doi.org/10.1001/jama.2023.14530

Rajski, P. (2002). Alcoholism and rebirthing. *International Journal for the Advancement of Counselling, 24*, 123–136. https://doi.org/10.1023/A:1020963817447

Rankaduwa, S., & Owen, A. M. (2023). Psychedelics, entropic brain theory, and the taxonomy of conscious states: A summary of debates and perspectives. *Neuroscience of Consciousness, 2023*(1), Article niad001. https://doi.org/10.1093/nc/niad001

Rebecchini, L. (2021). Music, mental health, and immunity. *Brain, Behavior, and Immunity – Health, 18*, Article 100374. https://doi.org/10.1016/j.bbih.2021.100374

Revonsuo, A. (2006). *Inner presence: Consciousness as a biological phenomenon*. Cambridge: MIT Press.

Rubin, B. K. (1983). *Cognitive, affective and physiological outcomes of rebirthing* (Doctoral thesis). American University, Washington, DC.

Rubin, M. (2021). When to adjust alpha during multiple testing: A consideration of disjunction, conjunction, and individual testing. *Synthese, 199*, 10969–11000. https://doi.org/10.1007/s11229-021-03276-4

Sandilands, O., & Ingram, D. M. (2024). Documenting and defining emergent phenomenology: Theoretical foundations for an extensive research strategy. *Frontiers in Psychology, 15*, Article 1340335. https://doi.org/10.3389/fpsyg.2024.1340335

Schmidt, T. T., & Fejer, G. (2021). Phenomenoconnectomics and the neural correlates of altered consciousness: An interview with Timo Torsten Schmidt by George Fejer. *ALIUS Bulletin, 5*, 59–74. https://doi.org/10.34700/wb76-w666

Schmidt, T. T., Prugger, J., & Hirschfeld, T. (2026, March 4). The Altered States Database (ASDB). https://doi.org/10.17605/OSF.IO/8MBRU

Sestieri, C., Corbetta, M., Romani, G. L., & Shulman, G. L. (2011). Episodic memory retrieval, parietal cortex, and the default mode network: Functional and topographic analyses. *Journal of Neuroscience, 31*(12), 4407–4420. https://doi.org/10.1523/JNEUROSCI.3335-10.2011

Seth, A. K., Suzuki, K., & Critchley, H. D. (2012). An interoceptive predictive coding model of conscious presence. *Frontiers in Psychology, 2*, Article 395. https://doi.org/10.3389/fpsyg.2011.00395

Smigielski, L. (2020). *Beyond the self and back: Neural mechanisms and behavioral imprints of a psilocybin-induced alteration of self-experience* (Doctoral thesis). University of Zurich. https://doi.org/10.5167/uzh-184592

Smigielski, L., Scheidegger, M., Kometer, M., & Vollenweider, F. X. (2019). Psilocybin-assisted mindfulness training modulates self-consciousness and brain default mode network connectivity with lasting effects. *NeuroImage, 196*, 207–215. https://doi.org/10.1016/j.neuroimage.2019.04.009

Srinivasan, N. (2020). Consciousness without content: A look at evidence and prospects. *Frontiers in Psychology, 11*, Article 1992. https://doi.org/10.3389/fpsyg.2020.01992

Stace, W. T. (1961). *Mysticism and philosophy*. London: Macmillan.

Studerus, E., Gamma, A., & Vollenweider, F. X. (2010). Psychometric evaluation of the altered states of consciousness rating scale (OAV). *PLoS ONE, 5*(8), Article e12412. https://doi.org/10.1371/journal.pone.0012412

Tagliazucchi, E., Siniatchkin, M., Laufs, H., & Chialvo, D. R. (2016). The voxel-wise functional connectome can be efficiently derived from co-activations in a sparse spatio-temporal point-process. *Frontiers in Neuroscience*, *10*, Article 381. https://doi.org/10.3389/fnins.2016.0038110.3389/fnins.2016.00381

Taves, A. (2020). Mystical and other alterations in sense of self: An expanded framework for studying nonordinary experiences. *Perspectives on Psychological Science, 15*(3), 669–690. https://doi.org/10.1177/1745691619895047

Thatcher, R. W., Krause, P. J., & Hrybyk, M. (1986). Cortico-cortical associations and EEG coherence: A two compartmental model. *Electroencephalography and Clinical Neurophysiology*, *64*(2), 123–143. https://doi.org/10.1016/0013-4694(86)90107-0

Thomason, M. E., Chang, C. E., Glover, G. H., Gabrieli, J. D., Greicius, M. D., & Gotlib, I. H. (2008). Default-mode function and task-induced deactivation have overlapping brain substrates in children. *NeuroImage, 41*(4), 1493–1503. https://doi.org/10.1016/j.neuroimage.2008.03.029

Timmermann, C., Bauer, P. R., Gosseries, O., Vanhaudenhuyse, A., Vollenweider, F., Laureys, S., Singer, T., Mind and Life Europe (MLE) ENCECON Research Group, Antonova, E., & Lutz, A. (2023). A neurophenomenological approach to non-ordinary states of consciousness: Hypnosis, meditation, and psychedelics. *Trends in Cognitive Sciences, 27*(2), 139–159. https://doi.org/10.1016/j.tics.2022.11.006

Timmermann, C., Sanders, J. W., Reydellet, D., Barba, T., Luan, L. X., Angona, Ó. S., Ona, G., Allocca, G., Smith, C. H., Daily, Z. G., Mason, N. L., Kloft-Heller, L., Kuchar, M., Janeckova, L., Palenicek, T., Erritzoe, D., Ramaekers, J. G., Carhart-Harris, R. L., & Uthaug, M. V. (2025). Exploring 5-MeO-DMT as a pharmacological model for deconstructed consciousness. *Neuroscience of Consciousness*, *2025*(1), niaf007. https://doi.org/10.1093/nc/niaf007

Tokariev, A., Palmu, K., Lano, A., Metsäranta, M., & Vanhatalo, S. (2012). Phase synchrony in the early preterm EEG: development of methods for estimating synchrony in both oscillations and events. *NeuroImage*, *60*(2), 1562-1573. https://doi.org/10.1016/j.neuroimage.2011.12.080

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: Distinguishing rumination from reflection. *Journal of Personality and Social Psychology, 76*(2), 284–304. https://doi.org/10.1037//0022-3514.76.2.284

Trehub, A. (2007). Space, self, and the theater of consciousness. *Consciousness and Cognition, 16*(2), 310–330. https://doi.org/10.1016/j.concog.2006.06.004

Tsakiris, M. (2010). My body in the brain: A neurocognitive model of body-ownership. *Neuropsychologia, 48*(3), 703–712. https://doi.org/10.1016/j.neuropsychologia.2009.09.034

Uddin, L. Q., Kelly, A. M., Biswal, B. B., Castellanos, F. X., & Milham, M. P. (2009). Functional connectivity of default mode network components: Correlation, anticorrelation, and causality. *Human Brain Mapping, 30*(2), 625–637. https://doi.org/10.1002/hbm.20531

Vago, D. R., & Silbersweig, D. A. (2012). Self-awareness, self-regulation, and self-transcendence (S-ART): A framework for understanding the neurobiological mechanisms of mindfulness. *Frontiers in Human Neuroscience*, *6*, Article 296. https://doi.org/10.3389/fnhum.2012.00296

Varela, F. J. (1996). Neurophenomenology: A methodological remedy for the hard problem. *Journal of Consciousness Studies, 4*, 330–349.

Velmans, M. (2014). Conscious agency and the preconscious/unconscious self. In S. Menon, A. Sinha, & B. V. Sreekantan (Eds.), *Interdisciplinary perspectives on consciousness and the self* (pp. 11–25). New Delhi: Springer.

Vigário, R. N. (1997). Extraction of ocular artefacts from EEG using independent component analysis. *Electroencephalography and Clinical Neurophysiology, 103*(3), 395–404. https://doi.org/10.1016/s0013-4694(97)00042-8

Windt, J. M. (2013). Reporting dream experience: Why (not) to be skeptical about dream reports. *Frontiers in Human Neuroscience, 7*, Article 708. https://doi.org/10.3389/fnhum.2013.00708

Windt, J. M. (2015). Just in time—Dreamless sleep experience as pure subjective temporality. In T. K. Metzinger & J. M. Windt (Eds.), *Open MIND*. MIND Group. https://doi.org/10.15502/9783958571174

Winget, C., & Kramer, M. (1979). *Dimensions of dreams*. Gainesville, FL: University Press of Florida.

Winkelman, M. J. (2024). Neurophenomenology and neuroepistemology approaches to integrating constructivist, perennialist, and universalist perspectives on mystical experiences. *Zygon: Journal of Religion and Science, 59*(2), 382–409. https://doi.org/10.16995/zygon.11589

Winkelman, M. J. (2025). Consilience in developing a multidisciplinary framework of spirituality: Scientific commentary on Chatlos. *Zygon: Journal of Religion and Science, 59*(4), 982–995. https://doi.org/10.16995/zygon.19023

Wittmann, M. (2015). Modulations of the experience of self and time. *Consciousness and Cognition, 38*, 172–181. https://doi.org/10.1016/j.concog.2015.06.008

Woźniak, M. (2024). How to grow a self: Development of self-representation in the Bayesian brain. *Frontiers in Human Neuroscience, 18*, 1441931. https://doi.org/10.3389/fnhum.2024.1441931

Zahavi, D. (2002). First-person thoughts and embodied self-awareness: Some reflections on the relation between recent analytical philosophy and phenomenology. *Phenomenology and the Cognitive Sciences, 1*, 7–26. https://doi.org/10.1023/A:1015568518276

Zahavi, D. (2005). *Subjectivity and selfhood: Investigating the first-person perspective*. Cambridge, MA: MIT Press.