INTERNATIONAL REVIEW OF PSYCHIATRY
https://doi.org/10.1080/09540261.2025.2478907

REVIEW ARTICLE

Neural filters to conscious awareness and the phenomena that reduce their impact

Marjorie Woollacott[a] and Marina Weiler[b]

[a]Institute of Neuroscience, University of Oregon, Eugene, OR, USA; [b]Department of Perceptual Studies, School of Medicine, University of Virginia, Charlottesville, VA, USA

ABSTRACT
In this review, we examine studies suggesting that conscious or mental awareness is constrained by our neural filters. These filters include sensory receptors, the ascending reticular activating system and the thalamus, the default mode network, and left hemisphere language centers. These filters limit our perception of the world to a narrow range of energy frequencies, make sense of space and time, and prioritize internally generated narratives (associated with language and conceptuality). We then present studies indicating that when the activity within these filters is reduced or absent—such as in near-death experiences, deep meditation, or the use of psychedelic compounds—we may gain access to a wider awareness, experience transcendence of time and space, and ego dissolution. This expanded state might enable the mind to potentially access intuitive, nonlocal information beyond the limitations of the five senses.

ARTICLE HISTORY
Received 4 August 2024
Accepted 8 March 2025

KEYWORDS
Consciousness; neural filters; transcendent experience; meditation; psychedelic compound

Introduction

The prevailing philosophical hypothesis concerning the ontological nature of reality is rooted in physicalism, or materialism, which asserts that all dimensions of human experience can be understood through fundamental biological processes. This perspective, grounded in classical physics, maintains that space and time are essential components of reality, and all aspects of mind and consciousness are produced by the brain and its associated neurophysiological processes (Cohen & Dennett, 2011; Kim, 2000).

To explain how we perceive reality, Broadbent and others developed the idea that the brain filters sensory information (Broadbent, 1958; Driver, 2001; Kelly & Kelly, 2007). Broadbent suggested that to selectively attend to specific stimuli, the brain must filter and extract relevant information from the overwhelming amounts of incoming sensory data. He proposed that the nervous system initially filters stimuli based on physical properties such as spatial location or pitch (in the case of hearing). In later stages, further filtering processes isolate features like the meaning of spoken words. This continuous filtering protects the processing system from overload, allowing focus to remain on the most relevant aspects of environmental information (Broadbent, 1958; Driver, 2001).

However, for over a century, many scientists have proposed that the brain functions as a filter to a more fundamental aspect of reality—consciousness itself. William James, often considered the father of American psychology, suggested that the brain significantly limits our access to a vast 'information field', which he referred to as the 'mother sea of consciousness'. Unlike many of his contemporaries, James argued that 'the brain transmits only a small portion of the information it receives to conscious awareness' (Bergson, 1896; James, 1902, 1976, 2007; Myers, 1904). This perspective, commonly known as the filter theory, posits that the brain serves a permissive or transmissive function, modulating access to an expanded consciousness or mind. James, along with Myers and Bergson, hypothesized that the brain is not the generator of mind and consciousness but rather an organ that adapts a broader consciousness to the practical demands of daily life. Under typical conditions, the brain acts as an interface, selecting, focusing, and constraining the processes of mind and consciousness.

CONTACT Marjorie Woollacott mwool@uoregon.edu Institute of Neuroscience, University of Oregon, Eugene, OR, USA

Theories proposing the primacy of consciousness (Hoffman, 2014; Kastrup, 2017; Kelly et al., 2015) often referred to as theories of non-local consciousness, challenge the notion that consciousness can be fully explained by neuronal activity within a causally closed system of purely physical processes. In this sense, nonlocal consciousness refers to the hypothesis that consciousness is a fundamental aspect of reality and that certain cognitive or perceptual phenomena may occur beyond the constraints of brain-based neural processing and standard sensory inputs. This idea suggests that under specific conditions—such as altered states, deep meditation, or near-death experiences—conscious awareness may extend beyond the individual organism, potentially interacting with an information field or broader cognitive domain not yet fully understood within current neuroscientific frameworks (Figure 1 illustrates this conceptual framework). Such theories propose that consciousness extends beyond the confines of the brain,[1] transcending conventional notions of time and space (Daw & Roe; Kuhn, 2024; Herce, 2016; Wahbeh et al., 2022; Van Lommel, 2013). From this perspective, space-time is seen as a construct of the observer rather than an objective, a priori reality. It is conceived as a representation proportional to the observer's potential knowledge—or, conversely, their ignorance (Hoffman, 2014; Hoffman & Prakash, 2014).

Neuroscientists have now identified many networks in the brain that serve as different types of attentional filters, reducing the overwhelming amount of information constantly bombarding the senses. Given the brain's limited processing capability, attentional filters that limit incoming information are essential to our ability to function effectively in daily life (Broadbent, 1958; Kelly & Kelly, 2007). However, one question that neuroscientists are also currently raising is whether these filters—while limiting much irrelevant information, and thus enhancing the possibility of survival within the world—, may also filter out information that allows for a more expansive perception of the world, the information that may contribute to perceptions of a wider awareness that intuitive and mystical experiences are made of (Brewer et al., 2011; Kelly & Kelly, 2007; Woollacott & Shumway-Cook, 2020).

In this review of the brain's filtering processes, we will first examine the function of identified filters (Figure 2), highlighting their positive attributes in contributing to selective attention and the individual's identity and role in the world. We will then explore research investigating potential expansions in perception when some of these filters are reduced in activity or eliminated. Such expansions can occur during deep

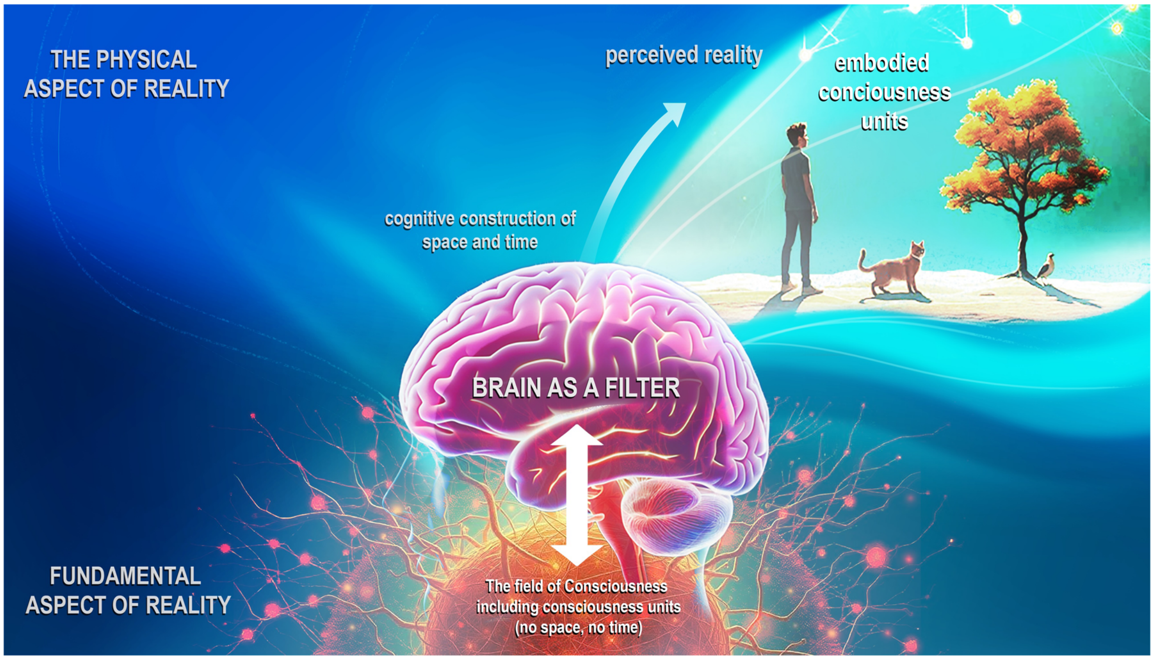

Figure 1. Brain filter theory and expanded consciousness. According to the brain filter theory, the brain functions as a filter that shapes our perception of reality by constraining a more fundamental consciousness (depicted at the base of the figure). Through this filtering process, we construct space, time, and a sense of self as separate entities (depicted in the upper portion of the figure). When these cognitive filters are weakened or bypassed—such as during near-death experiences, deep meditation, or the use of psychedelic compounds—our awareness may expand beyond ordinary constraints. This altered state can lead to a transcendence of time and space, ego dissolution, and access to intuitive, nonlocal information beyond the five senses.

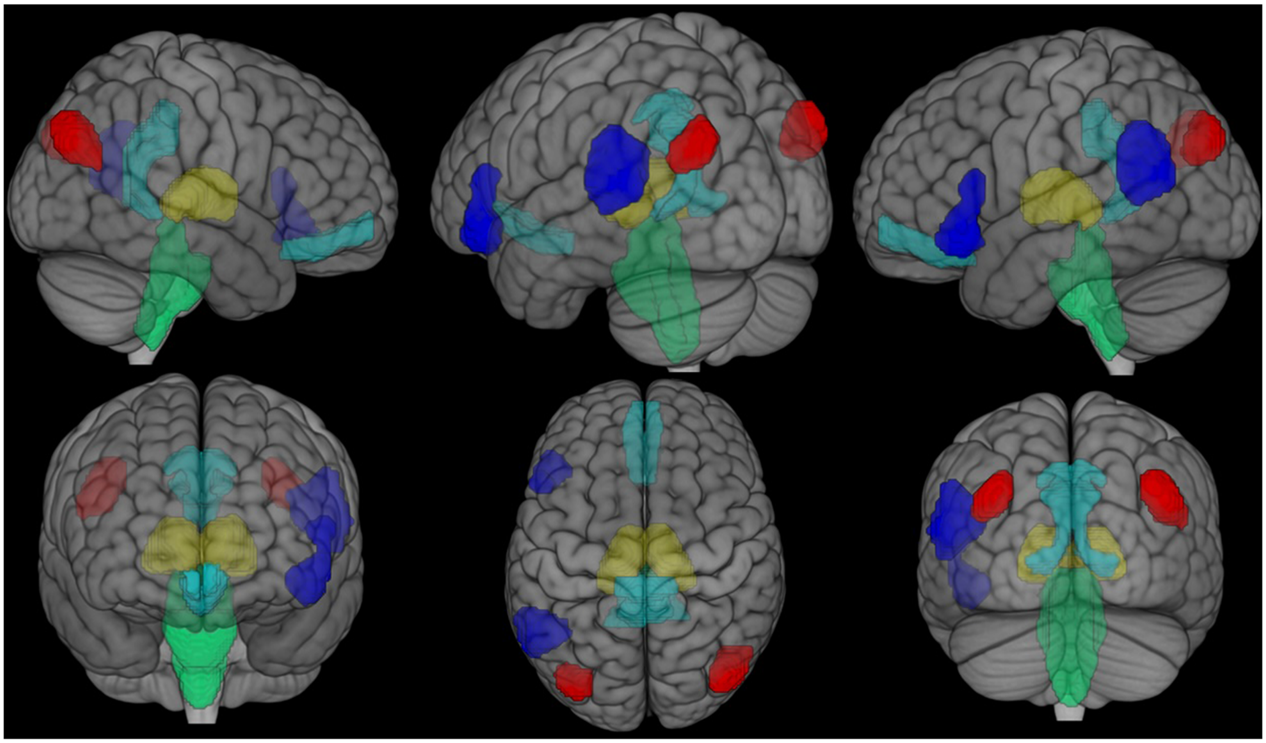

Figure 2. The location of neural filters that regulate access to expanded states of consciousness and the broader 'sea of consciousness'. These filters may function as a gating system that restricts access to non-ordinary states and non-local information, such as those reported in meditative, mediumistic, psychedelic, or near-death experiences. In green, the brainstem represents the Ascending Reticular Activating System; in yellow, the thalamus; in cyan, the medial prefrontal cortex and posterior cingulate cortex, regions of the Default Mode Network; in red, the posterior parietal cortex; in blue, the left hemisphere conceptual filters.

meditation, near-death experiences, cerebrovascular strokes affecting specific brain regions, psychedelic compounds ingestion, and trance states.

Sensory receptor bandwidths

Filtering of perceptual information begins at the very periphery of the individual, in the eyes, ears, nose, tongue, and skin, related to the physical properties of the receptors, before cortical filters further reduce access to vibratory sensory information. The five types of sensory receptors themselves canalize and restrict our perception of the electromagnetic, vibratory, and electrochemical information that exists all around us. Examples include the three pigments in the visual receptors, which only pick up 3 ranges of wavelengths (from 370 to 730 nm) out of the whole vibratory spectrum—what we perceive as variations of blue, green, and yellow colors (Kolb, 2011). Other species have a slightly broader perceptual sensitivity, with birds and certain insects sensitive to light vibrations in the ultraviolet range, and reptiles and fish perceive vibrations in the infrared range, both higher and lower than human visual perceptual limits (Klemas, 2013).

Similarly, the human auditory system is sensitive only to vibratory frequencies ranging from 20 to 20,000 Hz (Ehret & Göpfert, 2013). This means ultrasonic and infrasonic sounds are undetectable by the human ear, whereas other species, such as dogs, can hear sounds up to 45,000 Hz, and bats can detect vibrations up to 100,000 Hz (Barber et al., 2020; Strain, 2011). Finally, the human olfactory system is much poorer in sensitivity than many other mammals, including dogs and elephants, as it is capable of detecting and discriminating far fewer distinct molecules (Laska & Salazar, 2015; Von Dürckheim, 2021).

The ascending reticular activating system and the thalamocortical loop

Although additional filtering occurs at nearly every level of the nervous system hierarchy as sensory impulses ascend from the periphery to the central nervous system, the next major filter is the ascending reticular activating system (ARAS). The ARAS is a network of neurons primarily originating in the brainstem that plays a central role in filtering and regulating sensory input as it moves toward centers responsible for conscious awareness (Yeo et al., 2013).

Processes within the ARAS are believed to heighten the attentional state of specific neurons in the cortex, creating optimal conditions for the conscious perception of certain sensory impulses while filtering out others. Research indicates that sensory gating by the ARAS inhibits unnecessary sensory information from a sensory channel, allowing more salient information to pass to the cortex (Huang et al., 2023).

The ARAS is a component of the reticular formation primarily projecting to nuclei within the thalamus, a pivotal relay center in the mid-brain. The thalamus, along with the thalamo-cortical loop, regulates our attentional focus, enabling us to concentrate on specific aspects of our surroundings while filtering out extraneous sensory inputs. Without this selective filtering, the executive attention system in the prefrontal cortex would be inundated by peripheral sensory information relayed directly from the thalamus.

Another way that the thalamus takes this filtering even further is through the reverberating thalamo-cortical internal circuitry that competes with sensory inputs for attentional focus (Llinás & Parè, 1996). This internal loop from the cortex to the thalamus and back can dominate all our perceptions, with previous memories and our verbal stories. This means that, under normal conditions, brain inputs from our current thoughts can be more powerful than inputs from the world around us in creating our perception of reality. The manifestations of the processing of this internal circuitry are most obvious, for example, when one is out walking and realizes after a few minutes that they have not noticed any of the scenery they have passed by, due to being lost in the memory of a recent conversation with a colleague.

The Default Mode Network

The next filter discussed in this manuscript, the Default Mode Network (DMN), is associated with higher-order cognitive functions and serves as the source of the continuous background narratives and stories that shape our limited sense of self (Davey et al., 2016; Weiler et al., 2016). While in a resting or mind-wandering state, the brain is primarily engaged in the self-referential processing of emotions and thoughts, only interrupting this activity when attention is required for external stimuli or specific tasks. Notably, nearly 90% of the brain's energy consumption is dedicated to supporting the DMN (Passow et al., 2015).

The DMN is considered by many neuroscientists to be the source of the self-referencing nature of the ego (Carhart-Harris & Friston, 2010), the individualized notion of self that identifies with thoughts, emotions, and the diverse social roles one plays in the world (Davey et al., 2016; Raichle et al., 2001). Key regions of the DMN, including the posterior cingulate cortex (PCC) and the medial prefrontal cortex (mPFC), play pivotal roles in self-referential processing, autobiographical memory, and self-reflective thinking (Northoff & Bermpohl, 2004). Specifically, the PCC supports internally directed cognition, such as self-referential processing, autobiographical memory retrieval, and future-oriented planning (Kim, 2012; Leech & Sharp, 2014). The mPFC is crucial for processing self-referential information, particularly in emotional contexts (De Pisapia et al., 2019).

Using high-resolution functional MRI scanning in individual subjects, research has shown that areas involved in mental orientation in space, time, and person produce an adjacent pattern of activity that partially overlaps with the DMN (Peer et al., 2015). The anatomical adjacency and overlap between space, time, and person regions add neuroanatomical evidence for the interrelations between these domains on the cognitive level. Furthermore, the temporoparietal junction—a polysensory cortical area that converges somatosensory, auditory, and visual stimuli (Bremmer et al., 2002; Grüsser et al., 1990; Matsuhashi et al., 2004)—is closely associated with the ego dissolution phenomenon (Tagliazucchi et al., 2016). Collectively, the DMN contributes to the conceptualization of the narrative self as distinct and separate from the external world (Weiler et al., 2024).

Ego dissolution (also called ego loss, ego disintegration, ego death, or self-loss) refers to a profound alteration in the sense of self, where an individual's usual boundaries and sense of personal identity become less distinct or disappear entirely. During such experiences, the ordinary sense of self is replaced by a sense of union with an ultimate reality underlying all of manifest existence—the famous 'cosmic consciousness' experience (Letheby & Gerrans, 2017), and individuals no longer perceive themselves as a separate entity (Yaden et al., 2017). It should also be noted that though a complete dissolution of the self may be possible in some experiences, these shifts in awareness may be more typically seen as a sense of connection with others and the universe, but at the same time, keeping some sense of the self that perceives or is aware.

Left hemisphere conceptual filters

In addition to the narrative and added temporal and spatial filtering of the DMN, the left hemisphere networks are important conceptual filters. The left hemisphere brain areas are involved with different aspects of language processing, including Broca's area (involved in thinking about words and speech/language production), Wernicke's area (involved hearing words and speech/language comprehension and recognition), occipital lobe areas (involved in readings words), and motor cortex areas (involved in speaking words) (Sholihah, 2022). Furthermore, research has shown that the left hemisphere is involved in the processing of both concrete and abstract words (Binder et al., 2005), and logic (Baggio et al., 2016). Furthermore, the time-orientation system, which is crucial for our perception of time and temporal processing, is strongly lateralized to the left hemisphere (Peer et al., 2015). This specialization highlights the importance of the left hemisphere in our ability to organize and structure our experiences, as well as to navigate the temporal aspects of our lives effectively.

The right hemisphere of the brain, in turn, has been consistently associated with various cognitive and behavioral functions that differ from the more analytically oriented left hemisphere. Research has linked, for instance, the right hemisphere to the processing and perception of emotions (Lindell, 2013), as well as the facilitation of creative thinking (Hertenstein et al., 2019), intuitive decision-making, and holistic processing (Schore, 2014), and artistic expression (Mendez, 2004).

The relationship between language and perception has been a topic of growing interest among researchers. Emerging evidence suggests that language plays a pivotal role in shaping our perceptual experiences and thought processes. As Vulchanova et al. (2019) have compellingly demonstrated, the language regions of the brain are intimately involved in color perception during visual search tasks, enhancing the activation levels of specific portions of the visual cortex (Vulchanova et al., 2019). This finding underscores the notion that language functions not merely as a means of communication but as a filter and framer that directs our attention to certain aspects of the world, ultimately affecting the discrimination and prioritization of visual stimuli (Ting Siok et al., 2009).

Of note, the neuroanatomist Dr. Jill Bolte Taylor emphasized these differences between the left hemisphere language centers and the right hemisphere when she described her mental and emotional state after experiencing a stroke to the left side of her brain, in which she says she lost her language centers. She said: 'I shifted from the doing-consciousness of my left brain to the being consciousness of my right brain …from feeling small and isolated to feeling enormous and expansive' (pp. 68–69). She adds that immediately after the stroke, she had lost many of her brain's perceptual filters and thus felt that light was uncomfortable and that sound 'blasted her brain senseless' (Taylor, 2009, p. 72).

In the context presented, McGilchrist (2009) suggests that the dominance of the left brain in our mechanistic era has led to a diminished appreciation of more holistic perceptions of reality. Language, as a cognitive tool, helps bring certain aspects of the world into focus while relegating others to the background. This linguistic processing, in turn, divides the world into discrete components, with duality as a defining characteristic of most concepts. This perspective highlights the potential limitations of a left-brain-dominant approach and underscores the importance of maintaining a balanced and nuanced understanding of the world.

Summary discussion of the evidence for neural filters and possible constraints they impose on perception

We hypothesize that our conscious or mental awareness, which is fundamental and non-local (Theise & Kafatos, 2016), is typically restrained by the processes underlying these neural filters, thus limiting our experience to perceptions of our thoughts and our five senses (Figure 1). The benefit of sensory filters, the ARAS, and the higher-level DMN and language filters is that they screen out unnecessary environmental inputs, allowing us to focus on the information most critical for our survival. Filtering within the conceptual and language systems also enables us to concentrate on specific aspects of the world, facilitating the effective manipulation of objects within our environment.

These filtering mechanisms demonstrably limit one's perception of the world to a small range of energy frequencies (e.g. visual, auditory, olfactory). They also facilitate the dominance of internally generated narratives (associated with language and conceptuality) over sensory information through activity within the DMN and the thalamo-cortical loop. Additionally, these filters constrain our awareness of the perception of parts rather than a whole, a tendency associated with left-hemisphere dominance prevalent in modern cultures. As a result, we perceive a narrow bandwidth of the universe, focused on self-referential internal narratives that mask the connections and interdependencies between individuals and the environments they inhabit. What if these filters also limit our mental awareness of a broader reality, or what James referred to as the 'sea of consciousness'?

Research has shown that when these filters are disrupted or absent, individuals can enter what is commonly referred to as 'non-ordinary' or 'expanded states' of consciousness (Erritzoe et al., 2024), and expand their 'experiential repertoire' (Timmermann et al., 2023). Others use the term 'nondual awareness' (Cooper et al., 2022), which is characterized by a feeling free of boundaries between the self and the environment, transcending egoic consciousness (Tang et al., 2015). This is frequently accompanied by a profound sense of universal connection (Shaafi & Mehdi EL Amine, 2024), a noetic quality (i.e. the experience is perceived as objective truth), sacredness, bliss, peace, love, and distortions in space and time (Barrett et al., 2015; Griffiths et al., 2006). Individuals may report a perception of being 'at one with a larger whole' (Pedersen et al., 2021) or a deep connection with the universe (Mcculloch et al., 2022).

Relatedly, ego-dissolution—a state in which ego-boundaries (i.e. one's concept of self) dissolve, leading to a significant or complete loss of self-awareness—is often used to describe these experiences (Blatchford et al., 2021; Letheby & Gerrans, 2017; Stoliker et al., 2022; Van Mulukom et al., 2020). The self, comprising experiences, thoughts, emotions, and actions, defines who we are as individuals; during ego-dissolution, these defining elements are stripped away, leaving only pure awareness without a sense of self (Letheby & Gerrans, 2017).

In this manuscript, we propose that diminished activity in specific neurological filters may not only precipitate expanded states of consciousness but also enable access to nonlocal information that transcends the conventional boundaries of the five senses, space, and time. While a physicalist perspective often dismisses experiences of oneness as mere illusions resulting from atypical neural functioning during standard awareness, we present empirical data that challenge this notion. We recognize that reduced activity in the default mode network (DMN) and associated networks is well-documented in altered states of consciousness; however, the interpretation of these states as potential access points to an independent, non-brain-based reality represents an intriguing hypothesis that warrants rigorous experimental validation.

Phenomena that contribute to reducing the dominance of these filters

Deep meditation

There is a developing body of research that offers clues about processes that attenuate the brain's filtering functions. This emerging area of study includes investigations into various meditative practices that effectively reduce activity in the brain's DMN and the role of the executive system in this attenuation process (Raffone et al., 2019). For example, research has shown that two main nodes of the DMN—the PCC and the mPFC—were significantly deactivated during meditation sessions in long-term meditators compared to novice participants (Brewer et al., 2011). This finding suggests that the self-referential activity, a key function of the DMN that creates and sustains the experience of a separate self-sense, is significantly reduced during meditation in advanced practitioners (Carhart-Harris & Friston, 2010).

Schoenberg et al. (2018) studied advanced meditation in Indo-Tibetan Buddhist practitioners, exploring neural changes associated with deepening meditative absorption. This state involves a unified, compassionate experience of oneness, with diminished self-referential thoughts and a pervasive sense of interconnected consciousness. The research noted a significant reduction in DMN activity during the initial meditation phases. Specifically, between baseline and the first phase of meditation, as participants settled into the practice, there was a shift toward a more 'effortless' state, marked by a reduction in brain energy. This was evidenced by a decreased gamma current density vector across EEG frequencies and regions of interest, along with reduced activity in the DMN. As participants entered deeper meditative states, there was a slight progressive increase in brain energy. The researchers hypothesize that this is because the attainment of each state engaged more complex executive attention functioning and active alertness, culminating in a state described as 'brilliantly awake' (Schoenberg et al., 2018). Schoenberg and colleagues believe this change was not cognitively driven through intention, per se, but rather effortlessly sustained by the meditator. This is because global brain energy remained substantially lower than baseline levels.

To better understand the neural correlates of advanced states of concentrative and absorptive meditation, a review was made of phenomenology and neuroscientific studies of a type of meditation known as jhana (Yang et al., 2024). This meditation encompasses eight layers of deep concentration, awareness, and internal experience. It is achieved through intense concentration or absorption into an object of meditation resulting in a dissolution of spontaneous mental content. In one functional MRI study of a single jhana adept meditator (Hagerty et al., 2013), the authors found reduced activation in brain visual and auditory processing regions, as well as language, somatosensory, and posterior-parietal areas during the successive stages of meditation compared to resting states. The researchers note that these findings confirm the results described by Yang et al. (2024), which link these regions to deep absorptive meditation, characterized by decreased external awareness, reduced verbalization during intervals, and a diminished sense of spatial boundaries.

In another EEG study of 29 experienced jhana meditation practitioners (Dennison, 2019), disruption of the self-referential corticothalamic loop (discussed above as a prominent brain filter involved in the internal narrative) was reported. The study also revealed substantial changes in the neurophysiological signals during this jhanic meditation, reflecting significant disruption and inhibition of the default mode narrative processing, resulting in a volitional change in consciousness.

Could this reduced filtering, unbounded by egoic referential coordinates, be associated with a clearer, more subtle perception of reality? Several researchers have begun to hypothesize that this is indeed the case (Cooper et al., 2022; Kelly & Kelly, 2007; Woollacott & Shumway-Cook, 2020). Research has shown that deep meditative states can lead toward a global dissolution of the sense of self, with passive gestures of 'letting go' driving this dissolution (Nave et al., 2021). Furthermore, there is robust evidence that adept meditators can profoundly change the self-world structure of their experience, suggesting that these altered states of consciousness may enable a more direct and unfiltered perception of reality (Ataria et al., 2015; Dor-Ziderman et al., 2013).

First-person perspectives of the meditation process also support this understanding. In a study of the perceptual changes associated with his extensive meditation practice, a professor of psychology describes his own perceptual shifts after deep meditation (Walsh, 1983):

> Sensitivity and clarity frequently seem enhanced following a meditation sitting or retreat. Thus, for example, at these times it seems that I can discriminate visual forms and outlines more clearly. It also feels as though empathy is significantly increased and that I am more aware of other people's subtle behaviors, vocal intonations, and the like, as well as my own affective responses to them. The experience feels like having a faint but discernible veil removed from my eyes, and that the veil is made up of hundreds of subtle thoughts and feelings. Each one of these thoughts and feelings seems to act as a competing stimulus or "noise" that thus reduces sensitivity to any one object. Thus, after meditation, any specific stimulus appears stronger and clearer, presumably because the signal-to-noise ratio is increased. These observations provide a phenomenological basis and possible perceptual mechanism to explain the findings that meditators in general tend to exhibit heightened perceptual sensitivity and empathy. (pp. 43–44)

We believe that this scientist's first-person perspective of post-meditation perception—describing it as removing a discernible veil composed of hundreds of competing thoughts and feelings—is a powerful image that effectively captures the reduction in the functional filtering of the DMN.

Research has also explored the effect of deep states of meditation on the activity in left-hemisphere language centers and parietal lobe networks involved in spatial orientation. Using single photon emission computed tomography to measure changes in brain activity in advanced meditators, a study observed significant shifts when participants reached deep states of meditation associated with a clear feeling of unity-awareness (D'aquili et al., 2001). During these peak meditative states, participants transitioned from experiencing individuality to feeling a sense of oneness with the universe. Notably, at the height of meditation, there was a marked decrease in activity in the left hemisphere language centers and the orientation areas in the posterior parietal lobe.

Interestingly, deep absorption in the narrative of an experience may create a similar phenomenon to the experience itself. A study examining brain activity changes while participants were simply reading personally meaningful spiritual experiences, found that this was also associated with reduced activity in the left temporoparietal junction (Miller et al., 2019). More specifically, individuals described a situation in which they felt a strong connection with a higher power or a spiritual presence, a connection to something bigger than themselves, a oneness, or a strong force. These results suggest that the filtering processes related to conceptuality and spatial-temporal orientation were diminished, allowing for a broader awareness beyond conventional perceptions of time and space to emerge.

Is there evidence to suggest that meditators not only experience an expansion of awareness as a result of their practice but also gain access to non-local information? Research suggests that they do. A study by Radin and colleagues (Radin, 2015; Radin et al., 2011) asked if states of awareness of advanced meditators can transcend the usual boundaries of the subjective present. They investigated this type of experience in eight experienced meditators and eight nonmeditators, recording 32 channels of EEG before, during, and after exposure to unpredictable light and sound stimuli. They hypothesized that if some aspect of consciousness extends beyond the present moment, then prestimulus electrocortical signals would differ depending on stimuli that were about to be selected by a truly random process, and if these experiences were catalyzed through meditation practice, then prestimulus differences should be more apparent in meditators than in nonmeditators. Their results indicated that the control and meditator groups had significant prestimulus differences before audio tone stimuli in 14 of the 32 channels ($p < .05$, two-tailed, with eight channels showing $p < .005$, two-tailed). This suggests that a sense of awareness extending into the future may be cultivated through meditation. Importantly, Radin and colleagues address in their publication many potential arguments for flaws in their data and demonstrated how they carefully controlled for each possibility, including the presence of physical or probabilistic cues about upcoming stimuli, the use of inappropriate or ad hoc analytical methods, violations of statistical assumptions, anticipatory strategies, and statistical false positives. As a result, we are confident in the validity of their findings.

A second study exploring precognition in Tibetan Buddhist monks (Roney-Dougal & Solfvin, 2011) showed parallel results. The monks were asked to rate each of four pictures as to how likely it was to be selected randomly as the target to be viewed at the end of each session. They found that the two most experienced meditators (both lamas) had mean psi scores that were significantly above chance ($p = .04$). The experimental results of both studies indicated that these individuals were able to experience nonlocality in the time/space continuum, a phenomenon that is challenging to explain under the hypothesis that the brain is the sole creator of consciousness.

Psychedelic compounds

The research findings on meditation bear intriguing similarities to numerous studies exploring the effects of psilocybin on brain networks. Specifically, both deep states of meditation and psilocybin ingestion show comparable patterns of activity in the mPFC and PCC of the DMN, suggesting similar levels of deactivation in both states (Figure 3, [Barrett & Griffiths, 2018; Carhart-Harris & Friston, 2010; Thomas et al., 2017]). Surprisingly, the profound consciousness alterations under the influence of psilocybin were only associated with *decreases* in the regional blood flow specific to the hub regions of sensory and self-referential information processing in the thalamus, anterior and posterior cingulate, and mPFC. The authors suggest that psychedelic effects are primarily due to the release from DMN inhibition leading to 'unconstrained cognition' (Carhart-Harris et al., 2012). However, taking a physicalist perspective, they also propose that these effects stem from global increases in brain network integration, rather than from a reduction in the brain's filtering processes.

It is compelling to note that in both the meditation and psilocybin studies, lowering activity in the DMN was correlated with an increased sense of unity consciousness and ego-dissolution (Palhano-Fontes et al., 2015). In particular, many contemplative traditions explicitly aim at dissolving the sense of self by eliciting altered states of consciousness through meditation, while classical psychedelics are known to produce significant disruptions of self-consciousness, a phenomenon known as drug-induced ego dissolution (Letheby & Gerrans, 2017).

Barrett and Griffiths (2018) have documented first-person experiences of this phenomenon in their studies, showing the mystical nature of these experiences. One person said:

> It felt more real than any reality I have experienced… It was when I surrendered to this that I felt like I let go. I was gone… or should I say this earthly part of me was. I was in the void. This void had a strange and indescribable quality to it in that there was nothing to it but this feeling of unconditional and undying Love… Time and Space did not exist there. (Barrett & Griffiths, 2018)

Mediumship and shamanism

Although less studied than meditation and psilocybin experiences, trance states—particularly in the mediumistic practice of trance writing—also exhibit reductions in brain activity. Peres et al. (2012) found that expert mediums showed decreased brain activity during trance writing in multiple regions, including the left culmen, left hippocampus, left inferior occipital gyrus, anterior cingulate, superior temporal gyrus, and precentral gyrus. These areas are crucial for language processing and conceptual filtering. In contrast, novices exhibited a marked increase in activity across these same regions during trance writing. Notably, despite the reduced brain activity in experts, their written content was rated as more complex than their non-trance writing. Similarly, Delorme et al. (2013), using EEG, observed decreased theta power in the frontal region during high-accuracy segments of

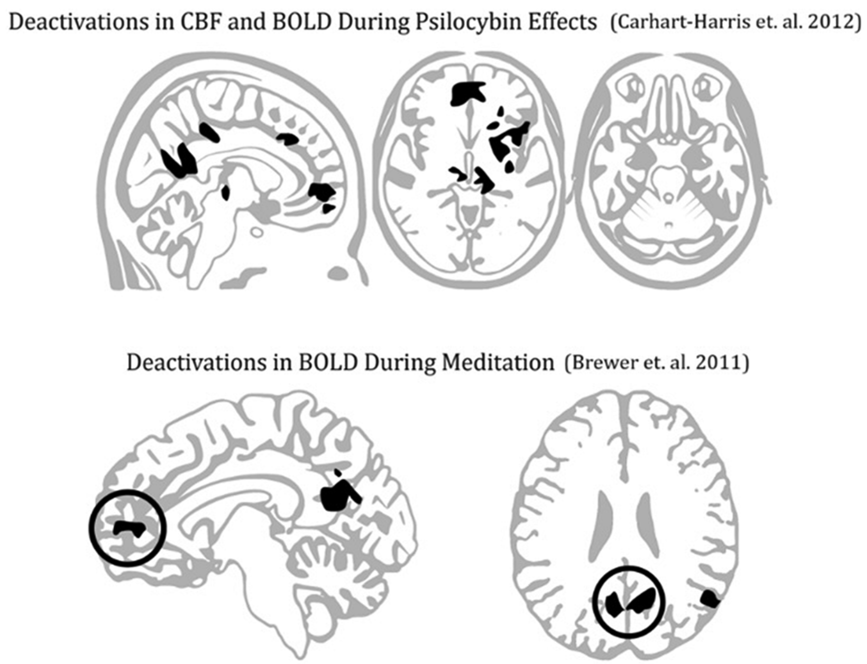

Figure 3. Comparable deactivations in the Default Mode Network were observed in two studies examining the effects of meditation and psilocybin. The top section of the figure highlights regions (black areas) where activity decreased following intravenous psilocybin administration. The lower section illustrates comparable regions within the medial Default Mode Network that exhibited decreased activity during meditation (Adapted from Figure 7, Similar deactivations in the medial default mode network during meditation and experience with psilocybin, p. 416, Barrett & Griffiths, 2018).

communication with the deceased, further supporting the link between altered brain activity and trance states.

Shamanism, a similar practice that allegedly engages in spirit-mediated healing and divination, involves a 'soul journey' in which some personal mental aspect of the shaman departs the body and travels to other places (Winkelman, 2010). It has been characterized as a form of focused and expanded state, closer to meditative states, in which the participant intentionally shifts their awareness from ordinary perception toward a different input, which seems to originate from within (Frecska et al., 2016). In a detailed spectral EEG study of a normal subject who was trained to induce a shamanic trance without the sound of the drum, researchers have found that the shamanic state of consciousness involved a shift from the normally dominant left analytical to the right experiential mode of self-experience (Flor-Henry et al., 2017).

An alternative hypothesis, grounded in the view that the brain is the sole producer of consciousness, suggests that these experiences are mere illusions resulting from disturbances in perception caused by diminished brain functioning. However, we argue this hypothesis is not well-supported. If reduced brain activity were responsible for producing these experiences, one would expect a corresponding decrease in the richness or intensity of the experience. Yet, as demonstrated in the cases discussed earlier, reduced brain activity often correlates with heightened awareness and enriched experiences, sometimes marked by hyper-awareness.

Near-death experience

Studies of the characteristics of awareness and brain activity during near-death experiences (NDEs) have also contributed important data to the question of the nature of the reduction in the filtering capacities of the brain when brain activity is reduced or absent (Greyson, 2003; Parnia, 2014; Schwaninger et al., 2002; Van Lommel et al., 2001). NDEs are profound psychological events that can occur to individuals who have come close to death or experienced extreme physical or emotional distress. These experiences often feature feelings of omniscience and oneness with all (Schröter-Kunhardt, 1993) and altered temporal perception (Wittmann et al., 2017). The experience of ego dissolution is also a common feature of NDEs, and its intensity increases with the richness of the experience (Martial et al., 2021).

Especially challenging to the neurosciences is the fact that these profound mystical experiences, characterized by a strong sense of connectedness and a dissolution of time and space, often occur during clinical death (a period of unconsciousness caused by a total lack of oxygen in the brain due to the arrest of circulation, breathing, or both). Without resuscitation, brain cells suffer irreversible damage within 5–10 min. While many authors have attempted to explain the phenomenology of NDEs as brain hallucinations caused by oxygen deprivation (Augustine, 2007) there remains a significant gap in fully accounting for NDEs through this explanation alone (Fenwick, 2007; Greyson, 2007).

The phenomenon of NDEs presents a particularly intriguing challenge within the realm of consciousness studies, especially when individuals recount veridical events that seemingly transcend the limitations of sensory perception. A notable case, narrated by a diligent nurse, exemplifies this phenomenon with remarkable clarity (Van Lommel et al., 2001). In this instance, a patient in a state of deep coma during cardiopulmonary resuscitation demonstrated an astonishing ability to accurately describe his surroundings, including precise details about the operating room, the nurse attending to him, and the presence of other individuals. Furthermore, he recounted the specific location of his dentures, which the nurse had placed aside before the resuscitation efforts. There is no plausible way the patient could have perceived this through the five senses, as they were in a coma. Additionally, we highlight the evidence compiled by Rivas, Dirven, and Smit, which documents over 100 verified veridical aspects of NDE cases. These include accurate perceptions of events occurring in operating rooms that could not have been accessed through the five senses, as well as perceptions of events taking place elsewhere in the hospital (Rivas et al., 2016).

Phenomenological parallels between psychedelic, NDE, and meditation experiences

To investigate parallels in the phenomenological effects of intensive meditation, psychedelic ingestion, and NDEs on perceptual experience, Woollacott et al. (2024) conducted a study comparing the experiences of meditation practitioners during a prolonged retreat to data from previous studies on the phenomenology of psychedelics and interviews with individuals who had NDEs (Woollacott et al., 2024). The meditation retreat, a Fire Kasina retreat, involved sustained focus on a candle flame or its after-image for 6.5–11 h per day over 18–22 days. Phenomenological data were collected using the Revised Mystical Experience Questionnaire (MEQ, (Barrett et al., 2015), which included subscales to quantify the mystical (feelings of unity, sacredness, and noetic quality; direct knowledge of insight), positive mood (joy, awe); transcendence of time/space, and ineffability of the experience.

A ‘complete’ mystical experience was previously defined as a score of 60% or higher on all subscales (Barrett et al., 2015). Participants in the Fire Kasina meditation retreat reported a mean MEQ score of 85%, comparable to scores observed with high doses of various psychedelics. For instance, psilocybin yielded mean MEQ scores of 77% (Griffiths et al., 2018) and 74% (Sweeney et al., 2022), 5-MeO-DMT produced a score of 83% (Barsuglia et al., 2018), LSD scored 73% (Sweeney et al., 2022), and DMT scored 82% for inhaled N, N-DMT, and 81% for ayahuasca (Sweeney et al., 2022). Interestingly, individuals who experienced an NDE had a mean MEQ score of 68% (Sweeney et al., 2022), which is slightly lower than the scores observed for participants in the intensive meditation retreat and those associated with psychedelic substances.

These findings support growing evidence that intensive, prolonged meditation can evoke phenomenological effects comparable to those of NDEs and psychedelics. In some cases, meditation may even surpass psychedelics in immersing individuals in profoundly mystical states of awareness.

Significance of the findings on expanded states associated with a reduction in brain filter function

The studies summarized in the latter half of this review identified significant reductions in activity across various neuronal filtering regions of the brain, which were associated with states of expanded awareness (Figure 2). These states were observed during practices such as deep meditation, the ingestion of psychedelic compounds, trance states, and cardiac-arrest-related NDEs. The results suggest that despite the varied triggers for these experiences consistent patterns of brain activity emerge. Specifically, these states are characterized by reduced activity in various neural filters, including those governing language and cognition, and a marked decrease in activity within the DMN, particularly in regions associated with spatial and temporal orientation.

The implications of these findings are profound. They suggest that the brain’s filtering mechanisms, which typically reduce the overwhelming influx of sensory information and build our sense of self, may also limit access to a broader spectrum of consciousness. We hypothesize that when these filters are diminished, individuals can experience a heightened state of connection, connecting with a more expansive perception of reality. This perspective posits that consciousness may be a fundamental component of reality, with the brain serving as a conduit that narrows the vast electromagnetic spectrum into a navigable experience. We anticipate that this manuscript will serve as a foundation for further empirical research to test this hypothesis, which is both crucial and warranted.

However, intriguing questions persist, particularly concerning the processing and retention of information during these altered states. How does the brain encode these experiences when critical areas, such as the ascending reticular formation and hippocampus, show minimal activity? This enigma leads to critical inquiries about the nature of memory and the mechanisms through which experiences, often lacking typical cognitive frameworks, are integrated into personal narratives.

Note

1. Other theories have also challenged the boundaries between the mind and the brain—for example, the concept of an "extended mind" proposed by Andy Clark (2013). However, Clark's theory differs from the filter theory as it does not imply the primacy of consciousness.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

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

Augustine, K. (2007). Psychophysiological and cultural correlates undermining a survivalist interpretation of near-death experiences. *Journal of Near-Death Studies*, *26*, 89–125.

Baggio, G., Cherubini, P., Pischedda, D., Blumenthal, A., Haynes, J. D., & Reverberi, C. (2016). Multiple neural representations of elementary logical connectives. *NeuroImage*, *135*, 300–310. https://doi.org/10.1016/j.neuroimage.2016.04.061

Barber, A. L. A., Wilkinson, A., Montealegre-Z, F., Ratcliffe, V. F., Guo, K., & Mills, D. S. (2020). A comparison of hearing and auditory functioning between dogs and humans. *Comparative Cognition & Behavior Reviews*, *15*, 45–94. https://doi.org/10.3819/CCBR.2020.150007

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

Barsuglia, J., Davis, A. K., Palmer, R., Lancelotta, R., Windham-Herman, A.-M., Peterson, K., Polanco, M., Grant, R., & Griffiths, R. R. (2018). Intensity of mystical experiences occasioned by 5-MeO-DMT and comparison with a prior psilocybin study. *Frontiers in Psychology*, *9*, 2459. https://doi.org/10.3389/fpsyg.2018.02459

Bergson, H. (1911). *Matter and memory.* (N. Paul and W. Palmer, Trans.). Allen and Unwin. (Original work published 1896).

Binder, J. R., Westbury, C. F., Mckiernan, K. A., Possing, E. T., & Medler, D. A. (2005). Distinct brain systems for processing concrete and abstract concepts. *Journal of Cognitive Neuroscience*, *17*(6), 905–917. https://doi.org/10.1162/0898929054021102

Blatchford, E., Bright, S., & Engel, L. (2021). Tripping over the other: Could psychedelics increase empathy? *Journal of Psychedelic Studies*, *4*(3), 163–170. https://doi.org/10.1556/2054.2020.00136

Bremmer, F., Klam, F., Duhamel, J. R., Ben Hamed, S., & Graf, W. (2002). Visual–vestibular interactive responses in the macaque ventral intraparietal area (VIP). *European Journal of Neuroscience*, *16*(8), 1569–1586. https://doi.org/10.1046/j.1460-9568.2002.02206.x

Brewer, J. A., Worhunsky, P. D., Gray, J. R., Tang, Y.-Y., Weber, J., & Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proceedings of the National Academy of Sciences*, *108*(50), 20254–20259. https://doi.org/10.1073/pnas.1112029108

Broadbent, D. E. (1958). *Perception and communication*. Pergamon Press.

Carhart-Harris, R. L., Erritzoe, D., Williams, T., Stone, J. M., Reed, L. J., Colasanti, A., Tyacke, R. J., Leech, R., Malizia, A. L., Murphy, K., Hobden, P., Evans, J., Feilding, A., Wise, R. G., & Nutt, D. J. (2012). Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(6), 2138–2143. https://doi.org/10.1073/pnas.1119598109

Carhart-Harris, R. L., & Friston, K. J. (2010). The default-mode, ego-functions and free-energy: A neurobiological account of Freudian ideas. *Brain: A Journal of Neurology*, *133*(Pt 4), 1265–1283. https://doi.org/10.1093/brain/awq010

Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences*, *36*, 181–204. https://doi.org/10.1017/S0140525X12000477

Cohen, M. A., & Dennett, D. C. (2011). Consciousness cannot be separated from function. *Trends in Cognitive Sciences*, *15*(8), 358–364. https://doi.org/10.1016/j.tics.2011.06.008

Cooper, A. C., Ventura, B., & Northoff, G. (2022). Beyond the veil of duality—topographic reorganization model of meditation. *Neuroscience of Consciousness*, *2022*(1), niac013. 2022, https://doi.org/10.1093/nc/niac013

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

Daw, M., & Roe, C. (2024). Theories of non-local consciousness: A review and framework for building rigour.

Dee Pisapia, N., Barchiesi, G., Jovicich, J., & Cattaneo, L. (2019). The role of medial prefrontal cortex in processing emotional self-referential information: A combined TMS/fMRI study. *Brain Imaging and Behavior*, *13*(3), 603–614. https://doi.org/10.1007/s11682-018-9867-3

Delorme, A., Beischel, J., Michel, L., Boccuzzi, M., Radin, D., & Mills, P. J. (2013). Electrocortical activity associated with subjective communication with the deceased. *Frontiers in Psychology*, *4*, 834. https://doi.org/10.3389/fpsyg.2013.00834

Dennison, P. (2019). The human default consciousness and its disruption: Insights from an EEG study of Buddhist jhāna meditation. *Frontiers in Human Neuroscience*, *13*, 178. https://doi.org/10.3389/fnhum.2019.00178

Dor-Ziderman, Y., Berkovich-Ohana, A., Glicksohn, J., & Goldstein, A. (2013). Mindfulness-induced selflessness: A MEG neurophenomenological study. *Frontiers in Human Neuroscience*, *7*, 582. https://doi.org/10.3389/fnhum.2013.00582

Driver, J. (2001). A selective review of selective attention research from the past century. *British Journal of Psychology*, *92*(1), 53–78. https://doi.org/10.1348/000712601162103

D'aquili, E., Newberg, A., & Rause, V. (2001). *Why God won't go away: Brain science and the biology of belief*. Ballantine.

Ehret, G., & Göpfert, M. C. (2013). Auditory systems. In *Neurosciences-from molecule to behavior: A university textbook* (pp. 337–362). Springer Berlin Heidelberg.

Erritzoe, D., Timmermann, C., Godfrey, K., Castro-Rodrigues, P., Peill, J., Carhart-Harris, R. L., Nutt, D. J., & Wall, M. B. (2024). Exploring mechanisms of psychedelic action using neuroimaging. *Nature Mental Health*, *2*(2), 141–153. https://doi.org/10.1038/s44220-023-00172-3

Fenwick, P. (2007). Commentary on 'Near-death experiences with hallucinatory features'. *Journal of Near-Death Studies*, *26*, 43–49.

Flor-Henry, P., Shapiro, Y., & Sombrun, C. (2017). Brain changes during a shamanic trance: Altered modes of consciousness, hemispheric laterality, and systemic psychobiology. *Cogent Psychology*, *4*(1), 1313522. https://doi.org/10.1080/23311908.2017.1313522

Frecska, E., Hoppál, M., & Luna, L. E. (2016). Nonlocality and the shamanic state of consciousness. *NeuroQuantology*, *14*(2), 155–165. https://doi.org/10.14704/nq.2016.14.2.934

Greyson, B. (2003). Incidence and correlates of near-death experiences in a cardiac care unit. *General Hospital Psychiatry*, *25*(4), 269–276. https://doi.org/10.1016/s0163-8343(03)00042-2

Greyson, B. (2007). Commentary on 'Psychophysiological and cultural correlates undermining a survivalist interpretation of near-death experiences'. *Journal of Near-Death Studies*, *26*, 127–145.

Griffiths, R. R., Johnson, M. W., Richards, W. A., Richards, B. D., Jesse, R., Maclean, K. A., Barrett, F. S., Cosimano, M. P., & 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

Griffiths, R. R., Richards, W. A., Mccann, U., & Jesse, R. (2006). Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance. *Psychopharmacology*, *187*(3), 268–283. https://doi.org/10.1007/s00213-006-0457-5

Grüsser, O. J., Pause, M., & Schreiter, U. (1990). Localization and responses of neurones in the parieto-insular vestibular cortex of awake monkeys (*Macaca fascicularis*). *The Journal of Physiology*, *430*(1), 537–557. https://doi.org/10.1113/jphysiol.1990.sp018306

Hagerty, M. R., Isaacs, J., Brasington, L., Shupe, L., Fetz, E. E., & Cramer, S. C. (2013). Case study of ecstatic meditation: FMRI and EEG evidence of self-stimulating a reward system. *Neural Plasticity*, *2013*, 653572–653512. https://doi.org/10.1155/2013/653572

Herce, R. (2016). Non-locality of the phenomenon of consciousness according to Roger Penrose. *Dialogo*, *3*, 127–134.

Hertenstein, E., Waibel, E., Frase, L., Riemann, D., Feige, B., Nitsche, M. A., Kaller, C. P., & Nissen, C. (2019). Modulation of creativity by transcranial direct current stimulation. *Brain Stimulation*, *12*(5), 1213–1221. https://doi.org/10.1016/j.brs.2019.06.004

Hoffman, D. D. (2014). The origin of time in conscious agents. *Cosmology*, *18*, 494–520.

Hoffman, D. D., & Prakash, C. (2014). Objects of consciousness. *Frontiers in Psychology*, *5*, 577. https://doi.org/10.3389/fpsyg.2014.00577

Huang, Z., Mashour, G. A., & Hudetz, A. G. (2023). Functional geometry of the cortex encodes dimensions of consciousness. *Nature Communications*, *14*(1), 72. https://doi.org/10.1038/s41467-022-35764-7

James, W. (1902). *The varieties of religious experience: A study in human nature*. Barnes & Noble Classics.

James, W. (1976). *Essays in radical empiricism*., Harvard University Press.

James, W. (2007). *Human immortality: Two supposed objections to the doctrine*. Cosimo, Inc.

Kastrup, B. (2017). An ontological solution to the mind-body problem. *Philosophies*, *2*, 10. https://doi.org/10.3390/philosophies2020010

Kelly, E. F., Crabtree, A., & Marshall, P. (2015). *Beyond physicalism: Toward reconciliation of science and spirituality*. Rowman & Littlefield Publishers.

Kelly, E. F., & Kelly, E. W. (2007). *Irreducible mind: Toward a psychology for the 21st century.*, Rowman & Littlefield.
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
Kim, J. (2000). *Mind in a physical world: An essay on the mind-body problem and mental causation*. MIT Press.
Klemas, V. V. (2013). Remote sensing and navigation in the animal world: An overview. *Sensor Review*, *33*(1), 3–13. https://doi.org/10.1108/02602281311294298
Kolb, H. (2011). *Facts and figures concerning the human retina*. In: Webvision: The Organization of the Retina and Visual System [Internet]. Salt Lake City (UT): University of Utah Health Sciences Center.
Kuhn, R. L. (2024). A landscape of consciousness: Toward a taxonomy of explanations and implications. *Progress in Biophysics and Molecular Biology*, *190*, 28–169. https://doi.org/10.1016/j.pbiomolbio.2023.12.003
Laska, M., & Salazar, L. T. H. (2015). Olfaction in nonhuman primates. In *Handbook of olfaction and gustation* (pp. 605–622). Wiley.
Leech, R., & Sharp, D. J. (2014). The role of the posterior cingulate cortex in cognition and disease. *Brain: A Journal of Neurology*, *137*(Pt 1), 12–32. https://doi.org/10.1093/brain/awt162
Letheby, C., & Gerrans, P. (2017). Self unbound: Ego dissolution in psychedelic experience. *Neuroscience of Consciousness*, *2017*(1), nix016. https://doi.org/10.1093/nc/nix016
Lindell, A. K. (2013). Continuities in emotion lateralization in human and non-human primates. *Frontiers in Human Neuroscience*, *7*, 464. https://doi.org/10.3389/fnhum.2013.00464
Llinás, R., & Parè, D. (1996). The brain as a closed system modulated by the senses. *The mind–brain continuum* (pp. 1–18). MIT Press.
Martial, C., Fontaine, G., Gosseries, O., Carhart-Harris, R., Timmermann, C., Laureys, S., & Cassol, H. (2021). Losing the self in near-death experiences: The experience of ego-dissolution. *Brain Sciences*, *11*(7), 929. https://doi.org/10.3390/brainsci11070929
Matsuhashi, M., Ikeda, A., Ohara, S., Matsumoto, R., Yamamoto, J., Takayama, M., Satow, T., Begum, T., Usui, K., Nagamine, T., Mikuni, N., Takahashi, J., Miyamoto, S., Fukuyama, H., & Shibasaki, H. (2004). Multisensory convergence at human temporo-parietal junction–epicortical recording of evoked responses. *Clinical Neurophysiology*, *115*(5), 1145–1160. https://doi.org/10.1016/j.clinph.2003.12.009
Mcculloch, D., Grzywacz, M., Madsen, M., Jensen, P., Ozenne, B., Armand, S., Knudsen, G., Fisher, P., & Stenbæk, D. (2022). Psilocybin-induced mystical-type experiences are related to persisting positive effects: A quantitative and qualitative report. *Frontiers in Pharmacology*, *13*, 841648. https://doi.org/10.3389/fphar.2022.841648
Mcgilchrist, I. (2009). *The master and his emissary: The divided brain and the making of the western world*. Yale University Press.
Mendez, M. F. (2004). Dementia as a window to the neurology of art. *Medical Hypotheses*, *63*, 1–7. https://doi.org/10.1016/j.mehy.2004.03.002
Miller, L., Balodis, I. M., Mcclintock, C. H., Xu, J., Lacadie, C. M., Sinha, R., & Potenza, M. N. (2019). Neural correlates of personalized spiritual experiences. *Cerebral Cortex*, *29*(6), 2331–2338. https://doi.org/10.1093/cercor/bhy102
Myers, F. W. H. (1904). *Human personality and its survival of bodily death*. Longmans, Green, and Company.
Nave, O., Trautwein, F.-M., Ataria, Y., Dor-Ziderman, Y., Schweitzer, Y., Fulder, S., & Berkovich-Ohana, A. (2021). Self-boundary dissolution in meditation: A phenomenological investigation. *Brain Sciences*, *11*(6), 819. [Online] https://doi.org/10.3390/brainsci11060819
Northoff, G., & Bermpohl, F. (2004). Cortical midline structures and the self. *Trends in Cognitive Sciences*, *8*(3), 102–107. https://doi.org/10.1016/j.tics.2004.01.004
Palhano-Fontes, F., Andrade, K. C., Tofoli, L. F., Santos, A. C., Crippa, J. A. S., Hallak, J. E. C., Ribeiro, S., & DE Araujo, D. B. (2015). The psychedelic state induced by ayahuasca modulates the activity and connectivity of the default mode network. *PloS One*, *10*(2), e0118143. https://doi.org/10.1371/journal.pone.0118143
Parnia, S. (2014). Death and consciousness—an overview of the mental and cognitive experience of death. *Annals of the New York Academy of Sciences*, *1330*(1), 75–93. https://doi.org/10.1111/nyas.12582
Passow, S., Specht, K., Adamsen, T. C., Biermann, M., Brekke, N., Craven, A. R., Ersland, L., Grüner, R., Kleven-Madsen, N., Kvernenes, O.-H., Schwarzlmüller, T., Olesen, R. A., & Hugdahl, K. (2015). Default-mode network functional connectivity is closely related to metabolic activity. *Human Brain Mapping*, *36*(6), 2027–2038. https://doi.org/10.1002/hbm.22753
Pedersen, W., Copes, H., & Gashi, L. (2021). Narratives of the mystical among users of psychedelics. *Acta Sociologica*, *64*(2), 230–246. https://doi.org/10.1177/0001699320980050
Peer, M., Salomon, R., Goldberg, I., Blanke, O., & Arzy, S. (2015). Brain system for mental orientation in space, time, and person. *Proceedings of the National Academy of Sciences*, *112*(35), 11072–11077. https://doi.org/10.1073/pnas.1504242112
Peres, J. F., Moreira-Almeida, A., Caixeta, L., Leao, F., & Newberg, A. (2012). Neuroimaging during trance state: A contribution to the study of dissociation. *PloS One*, *7*(11), e49360. https://doi.org/10.1371/journal.pone.0049360
Radin, D. (2015). Meditation and the nonlocal mind. *EXPLORE*, *11*(2), 82–84. https://doi.org/10.1016/j.explore.2014.12.011
Radin, D. I., Vieten, C., Michel, L., & Delorme, A. (2011). Electrocortical activity prior to unpredictable stimuli in meditators and nonmeditators. *EXPLORE*, *7*(5), 286–299. https://doi.org/10.1016/j.explore.2011.06.004
Raffone, A., Marzetti, L., DEL Gratta, C., Perrucci, M. G., Romani, G. L., & Pizzella, V. (2019). Chapter 9 - Toward a brain theory of meditation. In N. Srinivasan (Ed.), *Progress in brain research*. Elsevier.
Raichle, M. E., Macleod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode

of brain function. *Proceedings of the National Academy of Sciences*, *98*(2), 676–682. https://doi.org/10.1073/pnas.98.2.676
Rivas, T., Dirven, A., & Smit, R. H. (2016). *The self does not die: Verified paranormal phenomena from near-death experiences*. IANDS Publications.
Roney-Dougal, S. M., & Solfvin, J. (2011). Exploring the relationship between tibetan meditation attainment and precognition. *Journal of Scientific Exploration*, *25*. Retrieved from https://journalofscientificexploration.org/index.php/jse/article/view/32
Schoenberg, P. L. A., Ruf, A., Churchill, J., Brown, D. P., & Brewer, J. A. (2018). Mapping complex mind states: EEG neural substrates of meditative unified compassionate awareness. *Consciousness and Cognition*, *57*, 41–53. https://doi.org/10.1016/j.concog.2017.11.003
Schore, A. N. (2014). The right brain is dominant in psychotherapy. *Psychotherapy (Chicago, Ill.)*, *51*(3), 388–397. https://doi.org/10.1037/a0037083
Schröter-Kunhardt, M. (1993). A review of near death experiences. *Journal of Scientific Exploration*, *7*, 219–239.
Schwaninger, J., Eisenberg, P. R., Schechtman, K. B., & Weiss, A. N. (2002). A prospective analysis of near-death experiences in cardiac arrest patients. *Journal of Near-Death Studies*, *20*, 215–232. https://doi.org/10.1023/A:1015258818660
Shaafi, J., & Mehdi EL Amine, S. (2024). Understanding ego dissolution: A gateway to psychedelic therapy. Högskolan i Skövde, Institutionen för biovetenskap.
Sholihah, R. A. (2022). Language and brain: Neurological aspects in language acquisition. *MUHARRIK: Jurnal Dakwah Dan Sosial*, *5*(1), 220–230. https://doi.org/10.37680/muharrik.v5i1.1069
Stoliker, D., Egan, G. F., Friston, K. J., & Razi, A. (2022). Neural mechanisms and psychology of psychedelic ego dissolution. *Pharmacological Reviews*, *74*(4), 876–917. https://doi.org/10.1124/pharmrev.121.000508
Strain, G. M. (2011). *Physiology of the auditory system*. CABI Digital Library.
Sweeney, M. M., Nayak, S., Hurwitz, E. S., Mitchell, L. N., Swift, T. C., & Griffiths, R. R. (2022). Comparison of psychedelic and near-death or other non-ordinary experiences in changing attitudes about death and dying. *PloS One*, *17*(8), e0271926. https://doi.org/10.1371/journal.pone.0271926
Tagliazucchi, E., Roseman, L., Kaelen, M., Orban, C., Muthukumaraswamy, S. D., Murphy, K., Laufs, H., Leech, R., McGonigle, J., Crossley, N., Bullmore, E., Williams, T., Bolstridge, M., Feilding, A., Nutt, D. J., & Carhart-Harris, R. (2016). Increased global functional connectivity correlates with LSD-induced ego dissolution. *Current Biology*, *26*(8), 1043–1050. https://doi.org/10.1016/j.cub.2016.02.010
Tang, Y.-Y., Hölzel, B., & Posner, M. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience*, *16*(5), 312–312. https://doi.org/10.1038/nrn3954
Taylor, J. B. (2009). *My stroke of insight*. Hachette UK.
Theise, N., & Kafatos, M. (2016). Fundamental awareness: A framework for integrating science, philosophy and metaphysics. *Communicative & Integrative Biology*, *9*(3), e1155010. https://doi.org/10.1080/19420889.2016.1155010
Thomas, K., Malcolm, B., & Lastra, D. (2017). Psilocybin-assisted therapy: A review of a novel treatment for psychiatric disorders. *Journal of Psychoactive Drugs*, *49*(5), 446–455. https://doi.org/10.1080/02791072.2017.1320734
Timmermann, C., Bauer, P. R., Gosseries, O., Vanhaudenhuyse, A., Vollenweider, F., Laureys, S., Singer, T., 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
Ting Siok, W., Kay, P., Wang, W. S. Y., Chan, A. H. D., Chen, L., Luke, K.-K., & Hai Tan, L. (2009). Language regions of brain are operative in color perception. *Proceedings of the National Academy of Sciences*, *106*(20), 8140–8145. https://doi.org/10.1073/pnas.0903627106
Van Lommel, P. (2013). Non-local consciousness a concept based on scientific research on near-death experiences during cardiac arrest. *Journal of Consciousness Studies*, *20*, 7–48.
Van Lommel, P., VAN Wees, R., Meyers, V., & Elfferich, I. (2001). Near-death experience in survivors of cardiac arrest: A prospective study in the Netherlands. *Lancet (London, England)*, *358*(9298), 2039–2045. https://doi.org/10.1016/S0140-6736(01)07100-8
Van Mulukom, V., Patterson, R. E., & VAN Elk, M. (2020). Broadening Your Mind to Include Others: The relationship between serotonergic psychedelic experiences and maladaptive narcissism. *Psychopharmacology*, *237*(9), 2725–2737. https://doi.org/10.1007/s00213-020-05568-y
Von Dürckheim, K. E. M. (2021). Olfaction and scent discrimination in African elephants (*Loxodonta africana*). Stellenbosch University. 190 pp.
Vulchanova, M., Vulchanov, V., Fritz, I., & Milburn, E. A. (2019). Language and perception: Introduction to the special issue "Speakers and listeners in the visual world". *Journal of Cultural Cognitive Science*, *3*(2), 103–112. https://doi.org/10.1007/s41809-019-00047-z
Wahbeh, H., Radin, D., Cannard, C., & Delorme, A. (2022). What if consciousness is not an emergent property of the brain? Observational and empirical challenges to materialistic models. *Frontiers in Psychology*, *13*, 955594. https://doi.org/10.3389/fpsyg.2022.955594
Walsh, R. (1983). Meditation practice and research. *Journal of Humanistic Psychology*, *23*(1), 18–50. https://doi.org/10.1177/0022167883231004
Weiler, M., Acunzo, D. J., Cozzolino, P. J., & Greyson, B. (2024). Exploring the transformative potential of out-of-body experiences: A pathway to enhanced empathy. *Neuroscience & Biobehavioral Reviews*, *163*, 105764. https://doi.org/10.1016/j.neubiorev.2024.105764
Weiler, M., Northoff, G., Damasceno, B. P., & Figueredo Balthazar, M. L. (2016). Self, cortical midline structures and the resting state: Implications for Alzheimer's disease. *Neuroscience and Biobehavioral Reviews*, *68*, 245–255. https://doi.org/10.1016/j.neubiorev.2016.05.028
Winkelman, M. (2010). The shamanic paradigm: Evidence from ethnology, neuropsychology and ethology. *Time and*

Mind, *3*(2), 159–181. https://doi.org/10.2752/175169610X12632240392758

Wittmann, M., Neumaier, L., Evrard, R., Weibel, A., & Schmied-Knittel, I. (2017). Subjective time distortion during near-death experiences: An analysis of reports. *Zeitschrift Für Anomalistik*, *17*, 309–320.

Woollacott, M., Riddle, J., Hermansson, N., Sacchet, M. D., & Ingram, D. M. (2024). Fire Kasina advanced meditation produces experiences comparable to psychedelic and near-death experiences: A pilot study. *EXPLORE*, *20*(6), 103056. https://doi.org/10.1016/j.explore.2024.103056

Woollacott, M. & Shumway-Cook, A. 2020. The mystical experience and its neural correlates. *Journal of Near-Death Studies*, *38*(1), 3–25. https://doi.org/10.17514/JNDS-2020-38-1-p3-25

Yaden, D. B., Haidt, J., Hood, R. W., Vago, D. R., & Newberg, A. B. (2017). The Varieties of Self-Transcendent Experience. *Review of General Psychology*, *21*(2), 143–160. https://doi.org/10.1037/gpr0000102

Yang, W. F. Z., Sparby, T., Wright, M., Kim, E., & Sacchet, M. D. (2024). Volitional mental absorption in meditation: Toward a scientific understanding of advanced concentrative absorption meditation and the case of Jhana. *Heliyon*, *10*(10), e31223. https://doi.org/10.1016/j.heliyon.2024.e31223

Yeo, S. S., Chang, P. H., & Jang, S. H. (2013). The ascending reticular activating system from pontine reticular formation to the thalamus in the human brain. *Frontiers in Human Neuroscience*, *7*, 416. https://doi.org/10.3389/fnhum.2013.00416