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Feature Review

A neurophenomenological approach to non-ordinary states of consciousness: hypnosis, meditation, and psychedelics

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No contemporary unifying framework has been provided for the study of non-ordinary states of consciousness (NSCs) despite increased interest in hypnosis, meditation, and psychedelics. NSCs induce shifts in experiential contents (what appears to the experiencer) and/or structure (how it appears). This can allow the investigation of the plastic and dynamic nature of experience from a multiscale perspective that includes mind, brain, body, and context. We propose a neurophenomenological (NP) approach to the study of NSCs which highlights their role as catalysts of transformation in clinical practice by refining our understanding of the relationships between experiential (subjective) and neural dynamics. We outline the ethical implications of the NP approach for standard conceptions of health and pathology as well as the crucial role of experience-based know-how in NSC-related research and application.

Highlights

Non-ordinary states of consciousness (NSCs) induced by hypnosis, meditation, and psychedelics have become increasingly popular in research and clinical practice. However, no contemporary unifying framework has been proposed for their study.

A neurophenomenological (NP) approach for the study of NSCs provides a unique opportunity to rigorously investigate content-based and structural aspects of consciousness as dynamic (i.e., process-based), together with their embeddedness at multiple scales comprising brain, mind, body, and context.

We illustrate this by providing examples from research using traditional and NP approaches regarding the effects of hypnosis, meditation, and psychedelics on core experiences (e.g., agency, pain, and the sense of self)

The NP approach to NSCs stresses the importance of experienced-based know-how for their research and application, and has ethical implications related to the traditional conceptions of health and pathology.

Consciousness research and non-ordinary states of consciousness (NSCs)

Over the past two decades there has been increased interest in the study of consciousness, but several challenges remain. Obstacles to the study of consciousness include the poor reliability of naive experiential first-person reports [1], the inadequacy of (often binary) categorical cognitive taxonomies that poorly capture the breadth, nuances, and dynamic nature of human experience [2], difficulties in establishing the influences of culture and context on conscious experience [3], and the lack of effective means to study the relationship between the contents and structural features of conscious experience. These challenges translate to difficulties in studying the relationship between experiential (subjective) and neurobiological phenomena [4,5].

We present a neurophenomenological (NP) approach which combines first-person and neurophysiological data using disciplined methods (Box 1) for the study and understanding of NSCs. We broadly define NSCs as experiences that arise spontaneously or are induced by practices and/or rituals, and can have considerable cultural and eudaimonic (i.e., denoting well-being and meaning in life) significance. We prefer here the term 'non-ordinary' (rather than 'altered') states of consciousness (e.g., [6]) because we see these states as expanding the 'experiential repertoire' rather than being intrinsically different (in some fundamental way). NSCs are generally characterised by their transient (or acute) nature (i.e., states), but can also be used to target long-lasting transformation (i.e., traits) by impacting on cognition as well as on physical and mental health. A common feature of NSCs is to induce a shift in the way a subject, embedded in the taken-for granted world of everyday, usually experiences a specific content of consciousness, which may be accompanied or caused by a shift in experiential structure (e.g., perception of time and/or space, sense of agency and/or ownership). This 'taken-for-granted world of

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Box 1. The neurophenomenological (NP) approach to NSCs

The NP approach [4,20] emphasises the careful examination of experience using rigorous first-person methodologies inspired by phenomenology [99,152] in consciousness research. The central aim of NP is to integrate the phenomenal structure of experience into the characterisation of neural dynamics. During a conventional NSC study, the experimentalist may perturb a particular content and/or structure of consciousness (with the participant self-reporting the NSC using psychometric scales) to identify neural correlates of the NSC. The NP approach to NSCs extends this by actively involving the participant in describing specific and, arguably, more informative phenomenal invariants of experience. The disciplined process of becoming reflectively aware of one's experience becomes an explicit part of the experimental protocol (Figure 1).

The capacity of the participant for reflexive awareness, utilised by a skillful interviewer, enables access to tacit, preverbal, and prereflective aspects of subjective experience, which otherwise would remain simply 'lived through', thus rendering them describable as processes (i.e., a dynamic interplay of experiential content and structure). An iterative application of the rigorous phenomenological first-person methods allows the derivation of experiential categories for an empirical investigation using second- and third-person methods [20,153]. This in turn allows a more fine-grained characterisation of neural (or psychophysiological) dynamics, affording explanatory power over what is normally treated as inter- and intra-subjective 'noise'.

As an example, a pilot NP study using experienced meditators [76] was able to explain the variability in EEG data during the perception of visual stimuli. The source of EEG data variability was found to reside mainly in fluctuations in the cognitive processes of the subject, including the presence of spontaneous thoughts and strategy in performing the task. Thus, by guiding the investigation of brain dynamics using experiential clusters derived from first-person reports of trained participants, clear dynamical neural signatures of these clusters emerged, and these accounted for a large amount of variance in the neural cross-trial variability.

The introduction of practices involving the systematic training of attention and awareness (i.e., mindfulness meditation) is one strategy to increase the sensitivity of the participants to their own experience from moment to moment [4]. This may increase replicability and reduce the known biases of self-reports in the NP research. While the use of participants experienced in accessing and revealing otherwise 'hidden' experiential dynamics is not a hard prerequisite for the application of NP methods, the application of rigorous interview protocols by a skilled interviewer is essential.

everyday' standard mode of experiencing, which is perturbed during NSCs, has been referred to as the 'natural attitude' in the phenomenological tradition [7] or 'cognitive fusion' [8], 'reification' [9], 'absorption' [10], 'experiential fusion' [11], 'subjective realism' [12], and 'transparency' [13] in psychological and philosophical research.

The framework we outline focuses on three prominent families of NSC-inducing practices: hypnosis, meditation, and the use of psychedelics. We have chosen these practices because they have received significant attention in both contemporary neuroscience and clinical studies. Until now these fields have mostly been studied separately ([14–16] for some preliminary comparative empirical studies, and [17–19] for theoretical work bridging some of these practices), and their respective research practices have consequently developed in different ways.

In this integrative review we present a framework that can capture the contribution of the NP approach to the study of NSCs to enrich the field of consciousness science. We then illustrate this framework with examples of how NSCs make amenable the study of the central features of experience. Finally, we discuss the clinical and ethical implications of this approach.

An NP framework for the study of NSCs

Our main claim is that the NP approach to the study of NSCs may help to overcome some of the limitations found in the study of consciousness by providing broader and more reliable access to the richness of content and structure of experience. This approach further advocates incorporating the richness of the anthropological and eudemonic heritage together with NSCs into mainstream consciousness research, and by doing so advancing our understanding of the relationship between experiential, contextual, and neurobiological phenomena. Specifically, we propose that applying the NP approach to the study of NSCs provides an opportunity to

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illuminate structural and process-based features of consciousness (e.g., sense of self, experience of pain, agency, etc.) by perturbing these features and thereby making them experientially 'visible', thus allowing descriptions of these features to be made by participants using rigorous research protocols (Box 1).

Figure 1 illustrates the advantages afforded by using the NP approach to study NSCs. Figure 1A illustrates a standard approach to the study of NSCs. An ordinary perception of a nociceptive

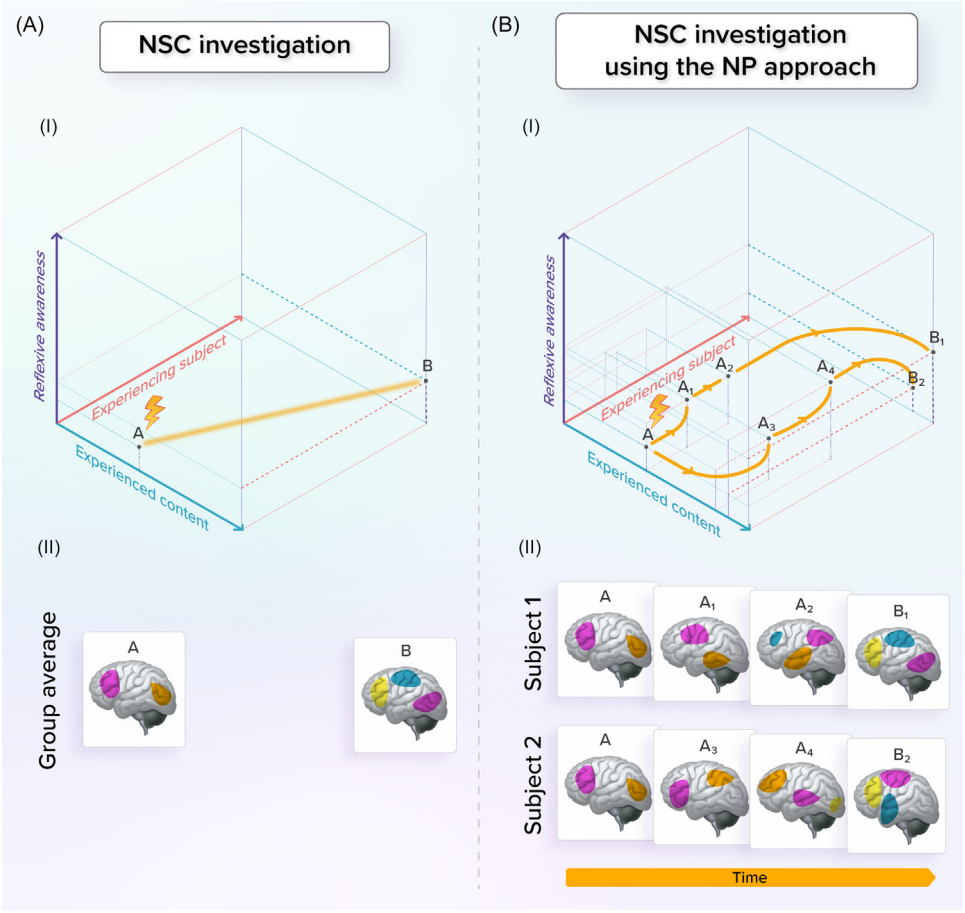

Figure 1. The neurophenomenological (NP) approach to non-ordinary states of consciousness (NSCs). (Ai) The experience of sensory stimulation, for example pain (state A), is perturbed (lightning symbol) during an NSC (state B). The NSC, for example induced using a hypnotic induction, shifts the content of experience (e.g., pain intensity/unpleasantness; *x* axis), its structure (e.g., the relationship of the subject with the pain sensation; *y* axis), and level/quality of awareness of the pain sensation (*z* axis) (the dimensions are illustrative for changes in structures of experience and do not imply orthogonality between them). (Aii) The neural correlates of experiential states A and B capture the content and structure of the ordinary and non-ordinary pain experience. However, without fine-grained first-person data to elucidate the dynamic changes in the content and structure of experience, it is not possible to differentiate the neural dynamics of content and structure or their interactions. (Bi) An induction of an NSC complemented by an NP approach (Box 1) renders dynamic changes in the content and/or structure of experience reflexively accessible and reportable (and potentially reproducible), revealing additional state transitions leading to different experiential trajectories (A→A1→A2→B1 vs. A→A3→A4→B2). For example, an NSC induced by meditation might lead to a heightened reflexive awareness, accompanied by a change in structure (e.g., reduced reactivity) which might in turn lead to a change in content (e.g., negative emotion). (Bii) The first-person data elucidating the experiential dynamics of content and/or structure changes allow a better understanding of the neural dynamics, affording a greater explanatory power of what is conventionally treated as 'inter- and intra- subjective noise' (brain activations shown are arbitrary).

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stimulation (state A) is transformed in response to a hypnotic suggestion, resulting in changes in the content of the sensation and the structure of the experience (state B) (panel Ai). For instance, a patient following a brief relaxation induction could be invited to visualise themselves in an agreeable location experienced in the past and to reappraise a nociceptive sensation as being only mildly unpleasant. The neural correlates of this NSC may be probed (panel Aii); however, lacking a rigorous examination of the dynamics of subjective experience does not allow differentiating the corresponding neural dynamics associated with the changes in the content and structure of experience as well as the dynamic interplay between the two. An NP approach (Figure 1B) employing rigorous methods of first-person data collection overcomes this limitation by capitalising on the fact that perturbations of 'ordinary' experience by NSC-inducing practices offer an opportunity for the individual to become aware of their habitual way to experience and react to the world. This then reveals the dynamics of both subjective experience (panel Bi) and neural data (panel Bii).

The fine-grained analysis of both subjective and neural dynamics of content/structure changes during an NSC also affords greater explanatory power for the variations in the outcome state (states B1 and B2) that normally would be obscured by group-level analysis. Arguably, taking stock of these dynamic fine-grained variations not only advances our understating of experiential and neurophysiological processes and their inter-relationships but also allows the development of more targeted and effective interventions for promoting mental health and well-being (discussed in the section 'From states to traits: clinical, epistemological and ethical implications for NSC practices').

For example, during mindfulness meditation, a practitioner may experience changes in the content and structure of pain. By intentionally anchoring one's attention in the body (i.e., a change in experiencing subject, *y* axis in Figure 1), the practitioner can more readily become aware of and disidentify with various processes related to nociceptive stimulation, such as anticipatory anxiety or catastrophising thought processes (i.e., enhanced reflexive awareness, *z* axis in Figure 1), which may reduce pain unpleasantness (i.e., structural change in the experienced content, e.g., sensory–affective decoupling, *x* axis in Figure 1). Reflexive awareness here refers to how when one consciously sees an object, one is also at the same time aware – intransitively, prereflectively, and passively – of one's seeing (e.g., [20]). This ability is particularly at play during meta-awareness (i.e., explicitly monitoring and noting the current contents of consciousness; details in [21]). Through such explicit monitoring of mental processes, the subject helps to guide the scientific study of these dynamics (Box 1). For example, a recent study [22] using fine-grained first-person data from mindfulness practitioners during pain experience revealed several experiential clusters with differential contents and/or structures.

In NSC-inducing practices, becoming aware of content/structure as a process of experience can be achieved by modulating (increasing or decreasing) the level of immersion into content through intersubjective guidance (e.g., hypnotic suggestion), metacognitive regulatory strategies (e.g., meditation), or pharmacological agents (e.g., psychedelics) (Box 2 for definitions). Although some NSCs may acutely reduce metacognitive processes via modulation of the structural features of experience (examples of hypnosis and psychedelics are given below), these modulations can enable the participant to enhance reflexive processes *post-factum* via disciplined mediation by for example an experienced facilitator [23]. By allowing such modulation of immersion into the contents of experience, supported by skilful intersubjective guidance (both within and/or outside the acute state of the NSC), the subject may become aware of the process-based nature of experience, leading to insights that might be transformative, potentially enhancing psychological well-being.

Box 2. Definitions of practices and domains

Hypnosis

Hypnosis is a multifaceted process consisting of "a state of consciousness involving focused attention and reduced peripheral awareness characterised by an enhanced capacity for response to suggestion" [154] or alternatively is a procedure involving the administration of verbal suggestions [26,131]. Hypnosis typically involves an interaction between two individuals in which a hypnotist administers an induction intended to facilitate absorption in subsequent communications and suspension of critical thinking [154], and targeted suggestions tailored to the respective phenomenon under study or for a symptom/condition. It has been used for nearly two centuries in clinical contexts, its main application being in pain management, but it has also been used for the treatment of other conditions.

Meditation

Meditation is a practice that is common to most religious, contemplative, and spiritual traditions. There is a wide variety of meditation practices in Western contexts, generally aimed at familiarising oneself with lived experience, stabilising and clarifying the mind, as well as cultivating positive human qualities such as altruism and compassion. This variety of practices may also lead to phenomenological and neurobiological differences between them. The main cognitive mechanisms involved include meta-awareness, focusing of attention, and cognitive defusion/dereification for mindfulness-related meditation [9], and perspective taking, cognitive reappraisal, or socioemotional processes for 'constructive' and analytical practices such as compassion meditation [11,155]. Forms of meditation have been adapted to and implemented in clinical settings, such as acceptance and commitment therapy (ACT), mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), and compassion-based therapy. There is increasing evidence for psychological, phenomenological, and neural effects on several psychological and physical conditions, and these are differentially affected by different meditation practices [108].

Psychedelics

Psychedelic substances have been historically used for (at least) hundreds of years in ritual contexts for a variety of different purposes. Psychedelics research was prominent in the 1950s and 1960s, following the accidental discovery of lysergic acid diethylamide (LSD). Their mechanism of action relates primarily to agonism at the serotonin 2A receptor, inducing significant changes in perception, affect, and cognition without loss of awareness at commonly used doses [156]. Psychedelics may induce visual imagery, somatic effects, increased attribution of meaning, feelings of insight or revelation, positive emotion, and so-called unitive, 'peak' or mystical-type experiences [37,157]. A surge of interest in psychedelics has occurred in recent decades for their use in consciousness research [60,158] and their potential for the treatment of mood, anxiety, and substance-abuse disorders, as well as in promoting general mental health and well-being.

By including rigorous first-person methods, the NP approach to the study of NSCs makes use of the reflexive capacity of the subject (and its modulation) to investigate process-based experiential features and associated neural dynamics, thereby providing gains in the neuroscience of consciousness research. Rigorously acquired first-person data can help to explain inter-and intra-subject 'noise' in third-person neuroimaging data [20], which is traditionally dealt with by averaging the data across the time-series within and between participants (Figure 1 and Box 1).

Perturbing the structures of consciousness during NSCs

Although a few NSC studies have implemented explicit NP methods, we first review research using more traditional approaches to illustrate how structural features of experience can be amenable to scientific inquiry via significant perturbations of experience, using commonly studied structural features of experience as examples: the sense of agency, physical pain, and the sense of self.

Sense of agency

Agency can be defined as the experience that some intentions and actions are internally generated by the individual, rather than by external objects or other individuals [24]. Hypnotic suggestions are communications for involuntary experiences (e.g., 'you will be unable to experience any sensation in your arm') that are experienced as if they happen to a person rather than being wilfully authored [25,26]. Among individuals displaying high hypnotic suggestibility, suggestions can produce pronounced alterations in the sense of agency, such that behaviours and experiences are

often perceived as unintentional and have a considerable sense of automaticity [24] by altering the usually perceived source and appraisal of one's behaviour and experience [27,28].

Studies of hypnosis suggest that a reduced sense of agency is associated with modulations of activity and connectivity in parietal regions that are commonly involved in sensorimotor congruency processes. Specifically, reduced activity in the supramarginal gyrus has been linked to reduced awareness during involuntary movements in highly suggestible individuals [29], whereas increased activity in the parietal operculum (PO) has been associated with perceived automaticity following a hypnotic induction without targeted suggestions in participants unscreened for suggestibility (Figure 2A), and posterior cingulate cortex (PCC) activity has been found to correlate with levels of hypnotisability [30]. Suggested loss of agency (initiation and control) of thought and movement is also associated with reduced activation of the supplementary motor area during targeted suggestions in highly suggestible individuals [31]. By perturbing the experience of agency, hypnotic suggestions may provide insights into the neurobiological mechanisms linked to this central aspect of conscious experience.

Meditation appears to either strengthen or attenuate the sense of agency depending on the meditation technique employed [32,33]. Studies using the classic Libet paradigm have shown that meditators are more aware of their impulses to act than are non-meditators [34,35]. Compared to non-meditators, meditators seemed to be aware of subjective concomitants of negative deflections of the slow cortical potentials that precede actions (i.e., button presses), which could reflect the crucial feature of being able to initiate the usually unconscious processes of a voluntary movement with awareness [35]. On the other hand, styles of meditation emphasising the 'letting-go' of experiences can attenuate the sense of agency and/or ownership [36].

Psychedelics appear to diminish the sense of agency acutely, including intentions, thoughts, and imagery [37], as well as to induce experiences of 'letting-go' of control pertaining to challenging emotions and thoughts [38]. In ritual uses of psychedelic-containing plants, extreme reductions in agency are commonly described during experiences of 'possession' [39].

Physical pain

Pain is a multidimensional experience comprising sensory-discriminative, affective-motivational, and cognitive-evaluative dimensions [40,41]. A traditional meditative account describes pain as being composed of two distinct 'arrows': an immediate physical sensation and a secondary (psychological) response linked to negative affect [42]. In support of this claim, individuals trained in mindfulness meditation (as secularly defined) seem to be able to uncouple the immediate pain sensation (e.g., the intensity of pain) from the affective reactivity to it (e.g., pain unpleasantness), allowing the physical component to be fully experienced, but with reduced emotional distress [43], a process that is intimately related to 'cognitive defusion' (the ability to gain psychological distance from internal experiences such as thoughts and feelings [44]) (Figure 2Bi).

Overall reductions in pain perception in meditators compared to meditation-naive individuals have been linked to increased activity in the insula and dorsal anterior cingulate cortex, as well as to decreased activation of the lateral prefrontal cortex, consistent with the notion that mindfulness meditation may facilitate the regulation of affective and cognitive processing during pain [44–46]. Furthermore, sensory-affective decoupling and reduced unpleasantness occurring during open monitoring meditation have been inversely associated with pain catastrophising scores [47]. This study also reported higher activity in the left anterior insula (aINS) and the anterior midcingulate cortex (aMCC) during pain, but decreased activity in these regions and the amygdala during pain anticipation, congruent with another report of a meditation-related decrease in anticipatory brain activity ([48]; *cf* [46]) (Figure 2Bii). Although pain-related activity in the aINS and

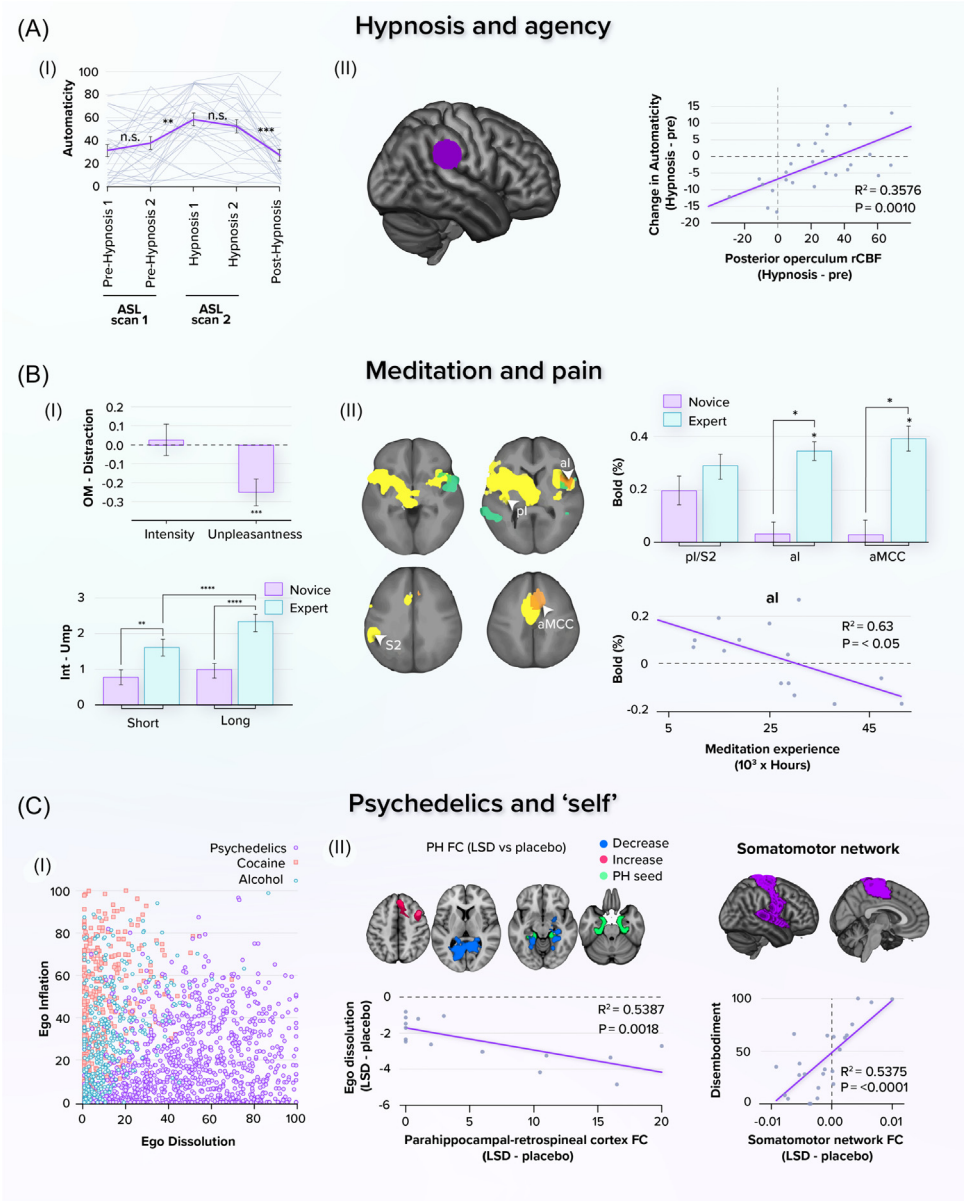

Figure 2. Effects of non-ordinary state of consciousness (NSC) on structural features of experience and their neuronal counterparts. (A) Hypnosis alters measures related to agency by increasing feelings of automaticity (i.e., non-voluntary responses to external suggestions) (Ai), which has been associated with increases in cerebral blood flow (CBF; measured using ASL) in the posterior operculum (Aii) [30]. (B) Mindfulness meditation supports a present-centred metacognitive stance that monitors and counteracts pain catastrophising while retaining openness to sensory experience. Instead of being immersed in pain, the practitioner becomes aware of their affective and motor reactivity to pain as a cognitive process, which induces sensory–affective uncoupling of the intensity of pain from its unpleasantness, ultimately regulating (reducing) the latter. Open monitoring meditation reduces the unpleasantness, but not the intensity of pain, and the duration (short vs. long) of perceived pain for experienced compared to novice meditators [106] (Bi). The regulation of pain unpleasantness by experienced meditators has been linked to increased activity (BOLD signal % change) in the anterior insula/salience network [47] (Bii). (C) Psychedelics disrupt experiential features associated with the sense of self, described using terms such as 'ego-dissolution' (a relaxation of subject–object distinctions [190]) or disembodiment [37]. This effect has been uniquely associated with psychedelics (left) compared to cocaine (middle) and alcohol

(Figure legend continued at the bottom of the next page.)

aMCC normally correlates with pain unpleasantness [49,50], this association was not present in meditators, suggesting that a different quality of attention to bodily sensations afforded by mindfulness changes the structure of physical pain experience by leaving only the first 'arrow' of bodily sensations, without the second 'arrow' of psychological suffering as 'pain' experience, thus allowing it to be experienced as a process (an ever-changing flux of sensations) rather than an affectively charged content, namely physical pain.

Hypnotic suggestion appears to modulate both sensory and affective components of pain [51]. Studies have shown brain changes in response to painful stimulation during hypnosis, including decreases in areas corresponding to the 'pain matrix' [52], modulation of S1, S2, insula, and parietal operculum (areas related to the sensory processing of pain) [53], as well as areas related to affective components, including the anterior cingulate cortex (ACC), insula, hippocampus, hypothalamus, and temporal cortex [54]. Furthermore, the impact of hypnotic suggestions on pain perception appears to be strongly associated with the modulation of ACC activation and its connectivity to areas implicated in nociception (i.e., insula, pregenual anterior cingulate cortex, superior frontal gyrus, thalamus, caudate nucleus, and brainstem) [49,55]. These findings seem to indicate that hypnotic suggestions modulate the structure of pain experience by a process of distracting participants away from the pain entirely, whereas meditation changes the structure of pain experience by a process of decoupling sensory from affective components.

Studies conducted in the 1960s–1970s, complementing anecdotal reports, suggest that psychedelics can reduce chronic pain symptoms associated with phantom limb, cancer, and cluster headaches [56,57]. Although the hypothesised mechanisms have been attributed to psychological (e.g., increased acceptance and agency related to the pain experience, acute modulation of bodily awareness, and mental imagery) and neural mechanisms (reorganisation of functional connectivity patterns, activation of the serotonin-2A receptor), more studies will be necessary to elucidate the specific mechanisms [56].

Sense of self

The 'self' is a multifaceted construct. Broadly, it includes an immediate sense of being a subject of experience (ownership) and an agent of action (agency) – the 'minimal self' arising from sensorimotor bodily self-awareness, as well as a temporally extended sense of identity that has access to autobiographic memories (the 'narrative self') [58]. This distinction between the 'minimal' and 'narrative' self is in line with early traditions of meditation stating that the sense of self can be deconstructed into various dimensions or levels [59]. Perturbations at varying levels of self-related processing during NSCs may provide clues about the experiential features and neuronal counterparts of various forms of 'selfhood' [17,36,60–62]. Psychedelics appear to reliably disrupt both narrative and minimal self-related aspects, resulting in attenuation/dissolution of the subject–object distinction that structures ordinary experience, which is commonly described as 'ego-dissolution' (Figure 2C) and is associated with feelings of 'oneness', 'boundlessness', or 'unity' that also appear to be central features of so-called 'peak', 'mystical' or 'non-dual' experiences [63,64].

Results from fMRI, magnetencephalography (MEG), and electroencephalography (EEG) studies have revealed that psychedelic-induced ego-dissolution relates mostly to alterations of

(right) ingestion [190] (Ci), and has been linked to neurobiological mechanisms implicated in various levels of self-related processing, including alterations in the connectivity of nodes pertaining to the default mode network (e.g., the parahippocampal gyrus [191]) and connectivity within the somatomotor network [70] (Cii). Abbreviations: AI, anterior insula; aMCC, anterior mid-cingulate cortex; ASL, anterior spin labelling; BOLD, blood-oxygen-level-dependent; FC, frontal cortex; Int, pain intensity; LSD, lysergic acid diethylamide; OM, open monitoring meditation; PH, parahippocampal gyrus; ps/S2, posterior insula and secondary sensory cortex; Ump, pain unpleasantness.

connectivity and activity of nodes of the Default Mode Network (DMN) which has been previously associated with narrative self-related processing [65]. Greater reductions in DMN metabolism, oscillatory power, and connectivity between its main hubs: medial prefrontal cortex (mPFC), PCC, and medial temporal areas, as well as decoupling of its activity from other brain networks, have been associated with higher levels of ego-dissolution [17,60,66–68]. Complementing these findings, psychedelics have been found to modulate brain systems implicated in the minimal self, such as multisensory integration, interoception, and sensorimotor processing, including the insula, cerebellum, and temporoparietal junction (TPJ), as well as the somatomotor and salience networks, accompanied by associated subjective changes in self–other distinction, ego-dissolution, and experiences of disembodiment [17,69–71] (Figure 2C).

Hypnotic induction without self-targeted suggestions has been shown to modulate some components of self-awareness, such as mental ease, orientation toward space and time, and self-monitoring [24]. Unscreened participants (i.e., not recruited based on individual levels of suggestibility) have been found to report an increase in self (internal) awareness and a decrease in external awareness, and the usual switches between the two (internal and external) were found to be decreased [72], whereas highly suggestible individuals typically experience spontaneous reductions in the sense of self following a hypnotic induction [73]. Targeted suggestions have been used to successfully induce out-of-body experiences, accompanied by associated deactivations of the TPJ [74], indicating alterations in the minimal self [75].

Although different meditation practices may differentially modulate the sense of self, mindfulness meditation attenuates narrative self-referencing accompanied by associated decreases in DMN activity and connectivity between its main nodes [17,33]. Psychometric questionnaires currently fail to distinguish between alterations in narrative versus minimal self-experience, but the use of an NP approach has proved fruitful in identifying changes in the minimal self in experienced meditators (see below).

NP studies of NSCs

The NP approach extends the contributions of NSCs to the study of consciousness beyond investigating 'state' changes during and/or after perturbation to understanding the dynamic interplay between the changes in the content and structure of conscious experience and its neural counterparts. Whereas the standard approach to the study of NSCs (including studies reviewed above) commonly relies on average ratings (of one or more categories) over the entire course of experience, NP methods incorporate in-depth first-person data to leverage the possibility of accessing the dynamics of experience. They do so by helping the participant to become aware of the 'how' of the experience either during or after the experience (via the process of evoking or recollecting), thereby enhancing the specificity of the studied phenomena at experiential and neural levels.

Although the validity of subjective reports has been debated extensively, advances have been made to improve the quality of experiential data and their inclusion within the NP framework [1,20]. Furthermore, the inclusion of first-person data has been shown to account for within- and between-subject variability, thereby increasing the specificity of inference regarding cognitive and neural processes [76].

Below we give examples of how harnessing the NP approach can advance our understanding of the neural dynamics associated with NSCs and aid consciousness studies more generally by making meaningful bridges between subjective experience and neural activity as well as helping to explain intra- and inter-subject 'noise'. We also provide an example of how the use of in-depth

phenomenological interview methods can help to generate experiential categories that could then be used in the studies using an NP framework.

A real-time neurofeedback fMRI study during focused attention meditation in experienced meditators with brief subjective reports post-scanning [77] revealed intriguing PCC activity dynamics. The effortless resting in undistracted awareness/concentration was associated with PCC deactivation, whereas 'efforting' (trying to meditate) and being distracted by spontaneously arising thoughts were associated with PCC activation increases. Notably, when spontaneous thoughts were arising during meditation but without the meditator being distracted by them (i.e., the meditator remained in the state of observation/cognitive defusion), PCC activity did not increase. Furthermore, this study provided evidence indicating that it is not mind-wandering/spontaneous mentation *per se* that drives PCC activity up, but instead narrative self-referential thoughts that proliferate with cognitive fusion – a 'sticky self'. Without combining neural data with subjective reports by meditators of their experience during scanning, this nuance about the role of PCC in mind-wandering and narrative self-referencing would not have been revealed.

An NP study using MEG in experienced meditators [78] investigated the states of neural activity associated with the experiential structures of 'timelessness' and 'spacelessness' and found them to overlap in networks related to the sense of the body, including the PCC, right TPJ, and cerebellum (mainly driven by the theta band). Based on first-person reports of self-induced timelessness and spacelessness experiences, the meditators were split into three groups: a both time and space group (BTS) who reported the loss of sense of boundary, a not both time and space (NTS) group who reported no boundary loss, and an out of body experience (OBE) group. Phenomenologically guided analysis enabled the dissociation of the three different groups at the neural level. Specifically, the BTS group showed lower right TPJ and insula theta power, accompanied by higher cerebellar activity, than the NTS group, whereas the OBE group was characterised by a marked reduction of PCC theta power compared to both the BTS and NTS groups. The study illustrates the utility of employing an NP approach for characterising the neural dynamics associated with meditation-induced alterations in the sense of time, space, and body, and shows its utility in dissociating different experiential structures of these experiences at the neural level.

Two NP studies employing MEG and in-depth phenomenological interviewing [36,79] allowed the classification of mindfulness meditation experience into discrete trials in which various degrees of the experience of selflessness (ego-dissolution) [36] and a sense of boundary [79] (i.e., structural features of experience) occurred. This permitted explaining within- and between-subject variability when determining the neural dynamics associated with the perturbation of the narrative self-awareness, which was linked with attenuated frontal and medial prefrontal gamma band power, and minimal self-awareness, which was linked to the attenuation of beta-band power in the right inferior parietal areas.

The findings of the MEG studies of meditation using the NP framework [36,78,79] are resonant with results from an NP study of the psychedelic *N*,*N*-dimethyltryptamine (DMT) [80]. The use of in-depth phenomenological interviews allowed the classification of the contents of experience (e.g., the visualisation of geometries) into dynamic categories of structural experiential features, which were then linked to specific neural dynamics. Thus, changes in bodily awareness were inversely correlated with central and parietal beta-band power, providing further evidence for the involvement of this frequency band in experiences of the minimal sense of self that are required for minimal self-awareness. Furthermore, the intensity of visual imagery was inversely correlated with alpha power and positively linked to delta and theta power.

Phenomenological investigation of hypnosis also reveals the dynamic nature of experience following a hypnotic induction. An NP study involving hypnotic induction without suggestions (neutral hypnosis) with online interviewing [81] identified categories derived from the contents of the hypnosis experience, including structural features of experience such as visual imagery and loss of agency. Intriguingly, the intensity of imagery experiences inversely correlated with alpha power and positively correlated with delta and theta power in low-hypnotisable individuals. Thus, both psychedelic and hypnosis NP studies were able to disentangle common mechanisms associated with visual imagery during NSCs (reductions in alpha power and increases in delta/theta power). Notably, these findings contribute to the notion that delta power may serve as a marker for conscious disconnection from the environment (usually via NSCs) rather than being a marker of unconsciousness, as was traditionally thought [82].

The final study to mention, although it does not employ neuroimaging, investigated strategies for pain regulation using in-depth interviewing of experienced meditation practitioners [22]. Five broad phenomenological structures of pain regulation were identified, including experiential avoidance, volitional agency distanciation, positive cognitive reappraisal, a non-judgemental metacognitive stance, and an altruistic stance with regards to the pain of others. These phenomenological structures were validated in a laboratory setting by predicting psychometric scores of pain perception in the same participants in a pain-induction experiment [22]. These phenomenological clusters could form the basis for future NP studies of the neural dynamics during pain regulation when investigating the effects of meditation or more generally.

Overall, the above studies illustrate the utility and potential of the NP approach in gaining a more fine-grained understanding of brain function and its relationship to subjective experience as a process (a dynamic interplay of content and structure) for NSC studies and beyond. They also provide evidence for the notion that deeper (and more reliable) access to subjective experience is possible, and more refined first-person data give greater explanatory power over the variance of neural data that is afforded by the use of psychometric scales.

Potential overlaps across different NSCs

It is presently largely unknown to what extent different forms of NSC impact on similar or different experiential and brain processes (see Outstanding questions). Some initial work has attempted to bridge these domains.

Evidence increasingly suggests that the experience of hypnosis, meditation, and psychedelics have an impact on the DMN. As reviewed above, psychedelics appear to modulate connectivity, activation, spectral power, and entropy-related mechanisms in the DMN hubs, especially in the PCC [60,83–88]. Similarly, research on meditation has shown that DMN activity, especially that of mPFC and PCC, is attenuated during forms of meditation that suspend narrative self-related processing [89–91]. Finally, hypnosis research has shown that inductions are associated with reduced activation of the mPFC and functional connectivity between the PCC and the executive control network [92], as well as reduced connectivity and/or activity of various DMN nodes [29,93]. Hypnosis studies have found reduced connectivity between the posterior midline and parahippocampal structures of the DMN, combined with increased connectivity between medial-prefrontal and lateral parietal DMN nodes [94].

The DMN has been implicated in longer-term changes following NSCs. Manualised mindfulness interventions appear to induce changes in prefrontal DMN areas, which are associated with narrative self-related processes, and in the insula, which is associated with interoception [95], as well as functional decoupling between the two [95,96]. Similarly, psychedelics appear to induce

lasting increased connectivity between some of the DMN nodes and reduced coupling between others, and these changes are associated with improved psychological outcomes [97,98]. A recent study [15] investigating the synergistic impact of meditation and psychedelics showed decreased decoupling between mPFC and PCC during open awareness meditation two days following a psilocybin-assisted meditation retreat compared to placebo. This decoupling was linked to higher levels of self-reported ego-dissolution occurring during the retreat. Conversely, increased coupling between mPFC and PCC was seen during the control resting-state condition. These effects predicted positive changes in psychosocial functioning of participants 4 months later [15]. Psilocybin-assisted meditation practice thus facilitated neurodynamic modulation of self-related networks, thereby underpinning (or enhancing) the process of meditation by acting along the anterior–posterior DMN connection.

These findings support the view that reduced DMN activity and connectivity during NSCs may reflect perturbation of internally oriented cognitive processes associated with the experience of a temporally extended narrative self, whereas the increased flexibility in DMN connectivity after an NSC may relate to trait-like changes that reflect a form of self-related model/belief updating. This supports the notion, discussed in the literature on the therapeutic use of psychedelics and meditation [17,33], that NSCs foster an experiential understanding (insight) that what is ordinarily experienced as a fixed content structuring experience (e.g., sense of self) is a fluid, context-dependent process, and this insight may drive the therapeutic (transformative) effects of both psychedelics and meditation. These studies also importantly highlight a possibility of 'transfer' from acute changes related to an NSC (state) to sustained psychological, behavioural, and neural effects (trait), but longer-term neuroimaging studies are necessary to determine the 'longevity' of such transfers.

From states to traits: clinical, epistemological, and ethical implications for NSC-inducing practices

Processes involved in NSCs are facilitated by a specific context, which can comprise physical, intersubjective, and motivational dimensions (Figure 3), that enables and guides the monitoring and regulation of habitual processes. This context is a central, active ingredient of most NSCs, as reflected in their embeddedness into specific practices, rituals, protocols, and traditions. The use of NSCs in indigenous, shamanic, religious, therapeutic, and ritual contexts illustrates the central importance of the specific forms of know-how that are required for the inquiry into human experience. Broadening this idea, the embedded nature of NSCs requires that methodologies for their study explicitly recognise and mobilise context and culture-specific settings (i.e., disciplined forms of know-how) in contemporary scientific settings. This emphasises the pragmatic role of first-person (e.g., specific meditation practices) or second-person intersubjective methods to guide the study of NSCs ([80,81,99–101] for examples), or to apply them in a therapeutic context [102,103]. Consequently, an NP approach to NSC involves characterising the interplay between brain, body, and environment at multiple spatial and temporal scales, and thus provides an opportunity to approach the study of consciousness beyond identifying mere brain-bound correlates.

Furthermore, the scientific investigation of NSCs may provide insights into human consciousness by expanding the validated knowledge of the experiential repertoire available to human beings beyond a simplified unidimensional conception of the presence versus absence of consciousness [104,105]. This broadening has epistemological and ethical implications by extending current definitions of normality of cognitive constructs and their boundaries. This is consistent with a perturbational approach to the study of consciousness, the focus of which is not only the biological human organism and its physical environment but also its experience and the wider intersubjective context in which the embodied organism is embedded [59].

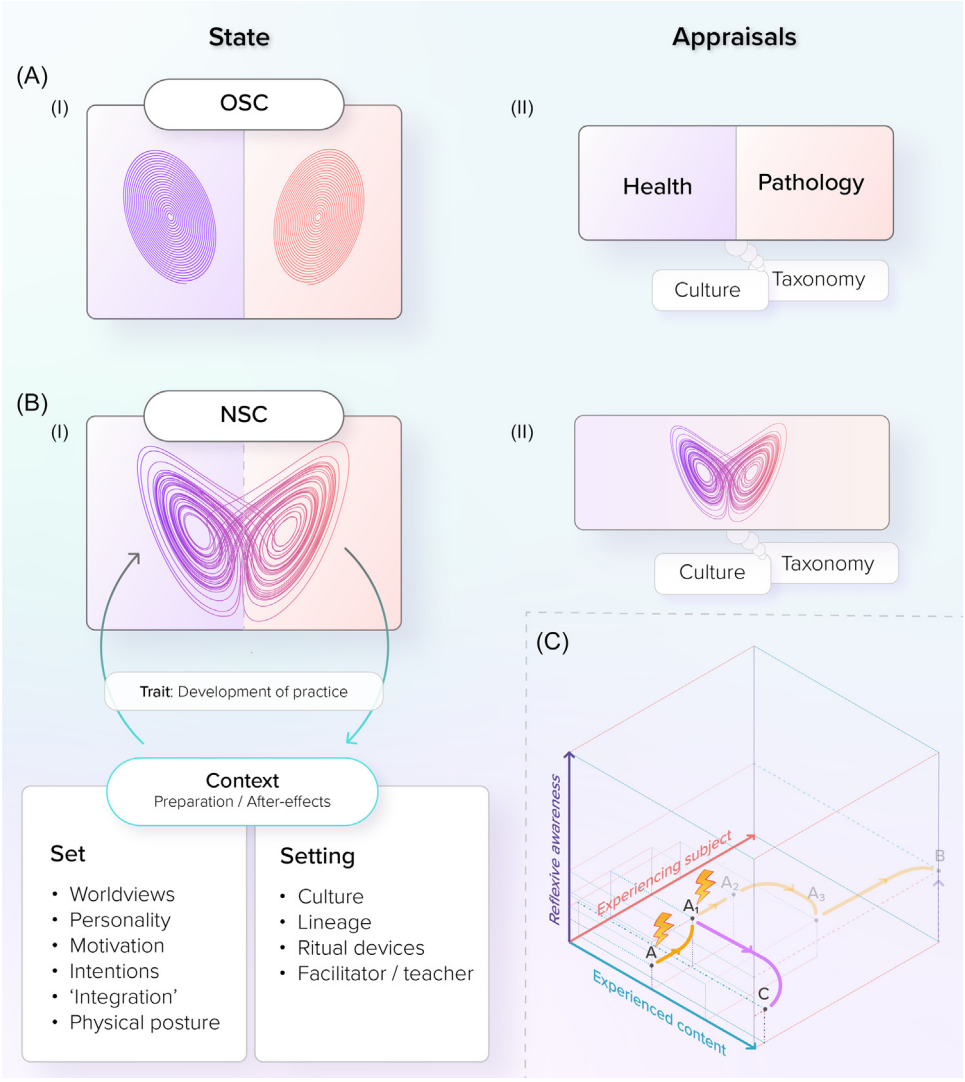

Figure 3. Embedded and ethical nature of non-ordinary states of consciousness (NSCs) across multiple temporal and spatial scales. (Ai) An ordinary experience (in purple, e.g., the sense of self) and its disruption (in red) fits within a standard appraisal of healthy and pathological states (e.g., depersonalisation disorder). (Aii) This taxonomy then guides cultural and ethical representations, as well as clinical decision-making (e.g., a binary separation between health (purple) and pathology (red) categories/biomarkers). (Bi) NSCs are interdependent with larger contextual variables (including personal and cultural factors, determining specific practices or rituals). NSCs across time can transform from states into traits (e.g., personality changes) and influence background contextual variables (e.g., cultural and scientific knowledge), which in turn influence NSC experiences, recursively. The experience of ego-dissolution can be a target state of specific NSC-inducing practices, and as such are not problematic within that specific context, but without such a context the same experiences can be highly disruptive. Within an NSC session, the participant can start on the left of the state space, then go to the right and return (represented by a Lorenz attractor to emphasise the non-linear dynamics of experience). (Bii) Such broadening of experiential repertoires has consequences for the individuals as well as for cultural and ethical definitions of normality, as illustrated by a dimensional and context-dependent approach to health and disease. (C) During an NSC, the mobilisation of context (symbolised as a perturbation of state A1) may be performed by an experienced facilitator, fostering the development of alternative experiential trajectories (state C), which can result either in enhanced well-being or 'impairment', both of which are defined relative to wider cultural norms. Abbreviations: NSC, non-ordinary state of consciousness; OSC, ordinary state of consciousness.

Personality traits and clinical outcomes related to NSCs

An experience-based approach to the study of NSCs (such as the NP approach) experimentally assesses these phenomena at multiple scales, including acute experiences (states), long-term effects (traits), and their embeddedness in the context and culture in which they occur (Figure 3). We briefly review evidence of NSC-related effects on personality and clinical outcomes.

Cross-sectional evidence indicates a relationship between meditation expertise or trait measures of meditation and various personality traits. For instance, expert meditators show less tendency for pain catastrophising than novices [106], and lower levels of suspiciousness and social anxiety [107]. Evidence from a longitudinal study shows that naive meditators reported changes after 9 months of intense daily meditation practice in a variety of trait measures of emotion regulation and coping styles, as well as in self-reported compassion and mindfulness [108]. Similarly, the use of psychedelics has been associated with increases in the personality domains of 'openness to experience' [109] and 'agreeableness', alongside decreases in 'neuroticism' [110], and a single psychedelic experience has been found to have lasting effects in worldviews and perceptions of reality [111]. Finally, some research suggests that training can be used to increase hypnotic suggestibility [112], which predicts responsiveness to hypnotic interventions for reducing pain in clinical and experimental contexts [113,114].

Furthermore, NSC-related changes have been associated with beneficial clinical outcomes across a variety of psychiatric conditions, including depression [115–118], anxiety [119–121], addiction [119,122–124], and pain-related conditions [56,106,113], as well as reduced stress and increased well-being in clinical and healthy populations [38,125]. These findings suggest that NSC-inducing states and practices, despite their different origins, may be efficacious in alleviating a broad range of aspects of human suffering as well as in promoting human flourishing (Box 3).

We speculate that these broad transformative effects of NSCs could reflect a general form of model (or belief) updating of maladaptive self-schemas mediated by the meta-cognitive and reflexive processes cultivated by these practices ([11,126,127] for similar formulations of the same idea). Importantly, preliminary findings suggest that the degree to which NSCs can induce favourable clinical outcomes is crucially dependent on the context (next section).

The role of context and know-how in NSCs

NSCs are embedded and influenced by contextual and/or environmental factors, which are likely to play a major role in the access, maintenance, and experiential features of the NSC, as well as the impact that the NSC will have on traits or clinical outcomes. This is naturally complemented by the NP approach which considers influences beyond the central nervous system (i.e., body, and environment) to be fundamental for the study of consciousness [4], and thus attributes a crucial role to context.

Figure 3 illustrates various internal and external factors that may constitute the context of an NSC-inducing session. These factors can be broadly divided into internal ('set') and external ('setting') factors (Figure 3B). The former pertains to facets such as the psychological state and traits of the individual before, during, and after a session (including the 'integration' of the experience into daily life), and the latter refers to aspects such as the physical environment, where a session takes place, the role of other participants, the presence and skill of the facilitator or therapist, as well as wider cultural and historical variables [128–131].

For example, evidence indicates that the capacity to respond to hypnotic suggestions is a trait with ~10–15% of the population displaying high hypnotic suggestibility [132]. Responsiveness

Box 3. Clinical findings

Hypnosis

Hypnosis has been increasingly proposed to patients (chronic pain, oncology, severely burned, phobic, during surgery, etc.) as a means to re-engage their cognitive resources and capacities to modulate pain and emotional distress and to improve their treatment and recovery of well-being [159–161]. The main clinical application of hypnosis concerns acute and chronic pain relief [113,114]; however, positive effects have also been observed for the treatment of depressive [162], anxiety [121,163], and post-traumatic stress disorder symptoms [164], as well as for smoking cessation [165]. Historically, hypnosis has been used in conjunction with other psychotherapeutic interventions (e.g., psychoanalysis and cognitive-behavioural therapy), as well as with mindfulness-based interventions [166] and psychedelics [18].

Meditation

The use of mindfulness and compassion-based meditation has become widespread in Western societies in education, politics, and the health sector. Mindfulness- and compassion-based interventions have been used to reduce stress in healthy individuals [125], as well as to improve quality of life in a wide variety of clinical conditions such as chronic pain [167], depression, anxiety, addictions [119], and oncology [168]. It appears to have a beneficial effect on these conditions by improving emotion regulation and decreasing rumination, as well as by providing opportunities for the individual to disengage (decentre) [12] from being immersed in feelings and/or thoughts.

Psychedelics

Preliminary trials suggest that psychedelics (in conjunction with psychological support) may induce lasting reductions in the symptoms of depression and anxiety in those with a diagnosis of major depression [116,169–171,192] anxiety [172,193], and in terminally ill patients with psychological distress [120,173]. Psilocybin was found to induce comparable reductions in depression symptoms when compared to a (gold standard) pharmacological (escitalopram) treatment [115]. In addition, significant reductions in drinking and smoking have been found in patients following psilocybin administration accompanied by psychological support [123,174]. Recent findings suggest that psychedelics may have enduring positive effects on well-being, prosociality, and nature-connectedness [38,175]. These effects on mental health are thought to arise from both experiential (e.g., mystical-type, emotional, or psychological insight episodes) and neurobiological plasticity mechanisms [176–180].

to suggestion is additionally influenced by expectations, the specificity of the suggestions, meta-awareness of the adequacy and appropriateness of responses during the session, the goals and motivations of the participants to respond, involvement in suggested images, and, finally, rapport with the hypnotist [131]. The outcomes of meditation appear to be influenced by psychological dispositions, the posture of the participant, and other contextual elements. For example, differences in prosocial behaviour were observed when comparing mindfulness training in combination with ethical teachings on virtuous human qualities with mindfulness training not involving these teachings [133]. Acute effects (e.g., visual and mystical-type) and beneficial clinical outcomes of psychedelic use appear to be predicted by baseline levels of trait 'openness to experience', trait absorption (related to the tendency to be immersed in mental imagery and hypnotic suggestibility), and readiness to 'surrender' to the experience [38,128], as well as the specific choice of music during a psychedelic session [134]. These findings highlight the intimate relationship between the skillful manipulation of context and clinical outcomes associated with the NSC-inducing practices.

The impact of contextual variables on NSCs is well described in the humanities but remains under-studied empirically [135]. This omission may reflect the initial focus (or bias) of modern treatment applications on cognitive processes or health-related outcomes rather than on contextual factors such as ethics, specific world-views and/or the spiritual lineage surrounding a practice [23,136]. The influence of wider contextual variables is of importance when considering the phenomenological features of specific NSCs since these appear to be highly susceptible to the historical and cultural framework in which they are embedded. For example, the use of well-defined practices, protocols, and/or rituals is the basis of practices related to hypnosis [137,138], meditation [139,140], and psychedelics [23,141] in historical and contemporary

contexts. The function of rituals in conjunction with a specific practice or substance might induce, enhance, direct, or maintain a state of consciousness (Box 4 and Outstanding questions).

Ethical implications

The contextual character of NSCs may have relevant ethical implications associated with conceptions that explicitly or implicitly underlie the medical taxonomy of health and pathology. For example, psychedelics (previously referred to as psychosis-mimicking or psychotomimetic states) have been used experimentally as models for psychotic symptomatology, and have provided insights into the role of the serotonin system in schizophrenia and associated disorders [142]. Indeed, in some instances NSCs may lead to undesirable mental health consequences such as anxiety and other detrimental clinical outcomes [23,143]. At the same time, the experiences induced by psychedelics are associated with increases in well-being and alleviation of a range of psychiatric conditions (Box 3). This seeming paradox [144] suggests that the association of these states with health or pathology (well-being or suffering) is highly dependent on the contextual variables and appraisals surrounding a given NSC [145] (Box 4). Similarly, the evidence suggests that appraisals of psychotic experiences may be key determinants of the psychological distress and the need for clinical care in people diagnosed with psychotic conditions [146].

Importantly, further ethical implications concern the explicit consideration of the role of experience-based know-how to complement empirical-based interventions, given that this helps to foster safety and desirable outcomes in practices employing NSCs. Examples of

Box 4. Evidence for the impact of context on NSCs

Hypnosis

Responsiveness to hypnotic suggestions is facilitated by trait factors (hypnotic suggestibility, expectations), meta-awareness of the adequacy and appropriateness of responses, the goals and motivations of the participants to respond, and rapport with the hypnotist [131]. The use of the terms 'hypnosis' or 'altered state' can increase or decrease (depending on the context) the responsiveness to suggestions, as compared to other terms (e.g., relaxation) [131,181], even in the absence of formal induction procedures. However, defining hypnosis as an altered state of consciousness may reduce the expectations of participants for treatment outcomes because of popular misconceptions about hypnosis. Verbal suggestions (without an induction) can alone be effective in modulating consciousness in highly suggestible individuals [182], and thus the incorporation of suggestion into other treatments represents a potential efficacious avenue for future research.

Meditation

For mindfulness and compassion-based meditation, preliminary research indicates that expectations and motivation appear to be important contributors to their therapeutic effect in clinical populations [130], as well as the relationship between the teacher and the group [183–185]. Meditation practices with different instructions have been found to have a differential effect on phenomenological, interoceptive, prosocial, and behavioural variables [108]. Furthermore, increased cortical thickness has been found in prefrontal regions for attention-based practices, increased plasticity in parietal and frontoinsular areas for socioaffective practices, and increased thickness in inferior frontal and temporal regions for sociocognitive practices [108].

Psychedelics

Psychedelic effects and outcomes in psychedelic-based therapy appear to be highly influenced by individual and contextual variables, including the physical, social, and cultural context, as well as by the baseline psychological (and neurobiological) states of the individual [128,129]. For example, an environment that provides feelings of safety, and skillful facilitation by a guide or therapist, appears to be crucial for safety and efficacy [129,141]. Furthermore, evidence suggests that the use of particular musical styles in psychedelic sessions favour experiences conducive to reductions in depression [134,186]. Baseline traits of absorption and 'openness to experience', as well as a psychological state of acceptance and 'surrender' have been linked to unitive experiences and enduring positive effects on mental health, whereas baseline levels of 'neuroticism' and psychological states of apprehension and confusion have been linked to challenging acute reactions [38,128,187]. Similarly, baseline brain function (power of theta waves) and morphology (cortical thickness of the PCC) may also be related to mystical-type states and changes in traits that have been attributed to psychedelics [188,189].

traditional, indigenous, and shamanic practices reflect the value of experience-based know-how when handling these practices safely and effectively [23,147–149]. This point is illustrated in Figure 3, where NSC-related practices are organically embedded in specific cultural and historical contexts in the form of a lineage or best clinical practices, and the role that the guidance by a skilled therapist or facilitator (a social actor occupying a second-person intersubjective position) may have during a session. For instance, the rapid expansion of mindfulness-based interventions was followed by the development of assessments of intervention integrity procedures to warrant the replication and validity of these programs [150]. Validation procedures may also follow informal paths of development: the development of many NSC therapeutic techniques is built upon the accumulation of practices used in indigenous, traditional, and/or contemporary therapeutic contexts [23,147,148]. There is now also explicit guidance to reduce harm and negative side effects in these practices (e.g., [141,151]).

Concluding remarks

Given the paucity of integrative research into NSCs, many questions remain open regarding the extent of overlap across NSCs in terms of experiential and neural dynamics, their 'place' in the current theories of consciousness, the nature of the relationship between states and traits/clinical outcomes, and the interdependence of NSCs and the contexts in which they occur (see Outstanding questions). Although these questions remain a future research objective, we believe that the approach we propose could render the relationship between experiential and neurobiological counterparts of consciousness more accessible, falsifiable, and possibly reproducible, thereby significantly advancing the field of consciousness research.

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Declaration of interests

The authors declare no conflicts of interest.

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Outstanding questions

Are there phenomenological invariants and neurobiological mechanisms that are common across different NSCs? The need to establish precise and consistent measures across studies investigating NSC practices remains crucial to determine potential areas of overlap.

Are NSCs amenable to unified computational accounts of brain function (e.g., predictive processing or the free energy principle, FEP)? Although separate attempts have been made for hypnosis, meditation, and psychedelics, is it possible to account for common neural and structural features across these states using the FEP framework? Can the FEP provide a useful framework to account for the influence of culture and context on NSCs?

How do NSCs relate to and potentially advance popular theoretical and methodological approaches in consciousness research, such as global workspace and integrated information theories?

NSCs can modify deeply anchored maladaptive processes and improve psychopathological conditions and biological markers related to stress. Do these changes reflect the direct impacts that NSCs may have on physical health or associated behaviours?

How can NSC-based clinical interventions be designed to harness the role of context (e.g., rituals, physical space, facilitator, virtual reality, etc.) and suggestions in clinical outcomes?

To what extent will the coupling of these procedures, such as the use of suggestions or meditation practices within psychedelic therapy, augment their efficacy?

How can first-, second-, and third-person accounts of NSCs be integrated and measured properly? How can qualitative first-person data be combined with cognitive, behavioural, psychophysiological, hormonal, and neuronal data in a fruitful, mutually informing and reproducible way across different NSCs?

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