
Hallucinatory altered states of consciousness

Levente Móró

Abstract Altered states of consciousness (ASC), especially hallucinatory ones, are philosophically and scientifically interesting modes of operation of the mind–brain complex. However, classical definitions of ASC seem to capture only a few common characteristics of traditionally regarded phenomena, thus lacking exact classification criteria for assessing altered and baseline states. The current situation leads to a priority problem between phenomena-based definitions and definition-based phenomena selection. In order to solve the problem, this paper introduces a self-mapping procedure that is based on a three-part analysis on certain aspects of hallucinatory altered consciousness. Starting with commonalities found in current definitions of ASC, issues with self-evaluation, sources of data, and baseline comparison are analyzed first. Next, the concept of alterations is examined with respect to temporal dynamics, change mechanisms, and mental subsystems. Finally, hallucinatory phenomena are discussed regarding various definitions, the relationship between “external” and “internal,” and the “trueness” issue of hallucinations. Conclusive to the analysis above, a technically based working definition of ASC and a stepwise operationalization procedure are also proposed.

Keywords Altered states of consciousness · Hallucinations

Introduction

The colorful spectrum of human conscious experience includes a multitude of scientifically and philosophically interesting phenomena. Dreaming, hypnosis, meditation, and various hallucinatory states are non-ordinary experiences that are commonly referred to as altered states of consciousness (ASCs). However, there are no commonly accepted definitions, but only partially agreeing descriptions of what an ASC is. On one hand, the lack of a unified definition has well-understandable practical reasons: Many types of phenomena are studied with a wide range of methods by a large variety of disciplines, but on the other hand, acceptance of a common definition is also hindered

L. Móró

Centre for Cognitive Neuroscience, University of Turku, Assistentinkatu 7, FI-20014 Turku, Finland
e-mail: leve@utu.fi

by more fundamental reasons, which concern the theoretical and conceptual basis of the whole ASC issue. Given the uncertainty concerning what is altered and how, the seemingly ever-ongoing debate on what exactly qualifies as a state, and the lack of a commonly accepted definition of consciousness itself, it is no wonder that ASC remains yet undefined. For establishing scientific theories and explanatory models about ASC, it is essential to examine the phenomena and their background assumptions in detail, from both theoretical and empirical aspects. Indeed, there are plenty of issues to look at. Which phenomena are regarded as ASCs and by what definitions? What counts as an alteration and what is a state? What exactly is getting altered and by what mechanisms? Or, how to tell apart hallucinatory altered “unreal” phenomena from “real” ones?

From the vast pool of diverse human conscious experience, only certain phenomena are commonly regarded as ASCs. Moreover, it is difficult to find commonalities in alterations of consciousness, as they may fundamentally differ from each other—or may greatly resemble each other despite cultural differences in time and place. Explicit listings of ASCs are mostly based on either commonly accepted traditional views or on classical definitions that can be challenged. On one hand, it could be a justified requirement for any categorization of ASC phenomena to be based on a solid theoretical definition. On the other hand, this definition should be based on the characteristics of actual ASC phenomena. These two simultaneous requirements may lead into a seemingly unsolvable mutual exclusion: There should be a prior selection of relevant phenomena that a definition should apply to, but there should be a prior definition to be used for selecting relevant phenomena. Lack of a prior selection or definition would potentially leave out relevant phenomena and/or include irrelevant ones, while a vague target group would render any ASC definition useless. What this paper proposes is that the precedent problem could be solved in an elegant way by using a self-mapping procedure. Such a procedure would not only avoid both arbitrary definitions and arbitrary selections at once, but would also yield a criterion-based target group to be described. For this purpose, a three-part analysis will be carried out. First, we take a look at certain commonalities that can be found in current ASC definitions. Then, to complement this with a definition-independent aspect, a detailed inspection into the concept of alteration is needed next. Furthermore, a special focus should be put on the phenomena of hallucinations, as one of the most prominent cases of ASCs. Summarizing the findings from these three aspects will reveal important criteria for a technical working definition of the ASC concept, as well as for an operationalizable assessment of altered consciousness—along with its unspecified comparative reference: baseline consciousness. As this paper aims only to describe the general lines of this procedure and not to actually carry it out, listings and examples will be neither extensive nor exhaustive but rather illustrative only.

Altered states of consciousness

In order to gather the related ASC phenomena that can be addressed by the self-mapping procedure, first, we should take a look at some ASC listings in the literature. In his classical book on the topic, Tart (1975) gives examples of discrete altered states of consciousness (d-ASCs): Nondreaming sleep, dreaming sleep,

hypnosis, alcohol intoxication, marijuana intoxication, and meditative states. Farthing (1992) specifies a longer list of major ASCs that are "relatively common and/or intensively studied": Sleep, the hypnagogic (drowsy presleep) state, hypnosis, various types of meditation, mystical, or transcendental experiences (including satori, samadhi, nirvana, and cosmic-consciousness), experimental sensory-deprivation experiences, and states produced by psychoactive drugs, such as alcohol, marijuana, lysergic acid diethylamide (LSD), and others. Vaitl et al. (2005) includes in the "list of domains associated with alterations of consciousness" the following: States of drowsiness, daydreaming, hypnagogic states, sleep and dreaming, near-death experiences, extreme environmental conditions (pressure, temperature), starvation and diet, sexual activity and orgasm, respiratory maneuvers, sensory deprivation, homogenization and overload, rhythm-induced trance (drumming and dancing), relaxation, meditation, hypnosis, biofeedback, psychotic disorders, coma and vegetative state, and pharmacologically induced states. In some cases above, it is unclear whether the associated domain of alteration refers to a state itself or to a method (or technique) inducing that state. Indeed, there are many cases where a clear distinction between method and state cannot be easily made. Induction methods may be practically equal to the resulting state, different induction techniques may be combined, a method could lead to different states, and similar states can be induced by very different methods (Tart 1975). However, a classification of induction methods might be also helpful in charting possible ASC candidates. By "origin or method of induction," Vaitl et al. (2005) separates consciousness alterations into five categories: Spontaneously occurring, physically and physiologically induced, psychologically induced, disease induced, and pharmacologically induced phenomena.

Next, we should compare and contrast at least a few current definitions of ASC. Perhaps the most classical definition of ASC was coined by Tart (1975) as: "A qualitative alteration in the overall pattern of mental functioning, such that the experiencer feels his consciousness is radically different from the way it functions ordinarily." Farthing (1992) gives the following definition in his textbook: "An altered state of consciousness is a temporary change in the overall pattern of subjective experience, such that the individual believes that his/her mental functioning is distinctly different from certain general norms for his/her normal waking state of consciousness." Concerning only the above definitions, three commonalities can be pointed out immediately. In all definitions, there is a self-evaluation criterion, i.e., the definitions are based on how the subject feels or believes about his/her state of consciousness (SoC). In addition, detected alterations occur in mental functioning, i.e., the definitions refer to the psychological domain as the source of data. Moreover, changes in mental functioning are referring to an (unspecified) ordinary or normal baseline state of the subject (by the subject himself/herself), i.e., there is a comparison involved. So next, these three commonalities are taken to a closer examination, in order to find out more about the justification of self-evaluation, data sources of alteration, and the state comparison procedure.

Although it seems intuitively right to use self-evaluation by the subjects as an ASC criterion, there are problems arising when a subject is left to make a final decision about whether his/her consciousness is altered or not. It could be reasonably argued that during an ASC, there can be such a fundamental alteration in the

subject's mental functioning that makes him/her incapable of an immediate self-reflection and self-state evaluation. While this observation may hold in certain ASC cases, there is no inherent ASC-specific functional impairment or diminished self-reflection mechanisms that a claim of incapability could generally refer to. However, a claim of incapability could still refer to a mode of operation that may be functionally incompatible with the requirements of self-evaluation. In other words, it can be argued on a purely theoretical basis that a subject cannot adequately compare an ASC (as he/she cannot properly reflect on the ASC while inside that ASC) with the baseline SoC (which is not present there during an ASC). This argument generally suggests that self-evaluation cannot be a definitive proof of any state, if it is based only on an instant comparison that uses either present or absent states as references. Indeed, there exist many examples of discrepancies between subjective self-evaluation and objective evaluation. Such cases are, for instance, the placebo effect (where an inert medication or sham treatment may lead to improvement in persons who believe in the intervention), the anecdotic contact high phenomenon (where a person may experience mood-enhancing effects from mere social interaction with drug users who are in a positive mood), or anosognosia (where a person seems unaware of or denies the existence of his/her physical impairments), but rejecting self-evaluation as a criterion does not imply rejecting subjectivity or introspection per se. On the contrary, it is to be acknowledged and emphasized here that first-person data about subjective experiences are of great importance in finding out more about a subject's mental functioning—be it baseline or altered state. In order to back up this prematurely conclusive claim, it is time to examine the next commonality found in the definitions: What are the domains that may serve as data sources about alterations of mental functioning? To answer this question, Tart's (1975) remark can be of help: "A SoC is thus defined not in terms of any particular content of consciousness, or specific behavior or physiological change, but in terms of the overall patterning of psychological functioning." Here, Tart clearly utilizes a multilevel view, together with a declared emphasis on a psychological approach. Moreover, his remark contains references to three substantially different data sources, which are to be inspected next.

Firstly, "content of consciousness" refers to the subjective experience, with the phenomenal content being the particular data. It is to be noted immediately that phenomenal content is neither the only type of content nor the only type of subjective data available. Verbal reports can also contain reflections on the subject's own mental processes, regardless of the actual content that the subsystems are processing. Thus, it is rather the how (the workings of the content processing mechanisms and the way such contents impact our mental sphere) than the what (the current content that is being processed) which matters when trying to factor in the contents of consciousness. Concerning methodology, descriptive introspection is indeed prone to various errors of reporting (in general), such as forgetfulness, censorship, demand-biased reporting, difficulties in the verbal description of ineffable experiences, and confabulation (Farthing 1992). Still, introspective reports can provide the most direct and detailed first-person data on the subjective experience. In practice, the above-listed types of errors may be reduced—thus report quality and accuracy may be enhanced—with preparatory training sessions in self-expression for the subjects.

Secondly, there is a reference to “behavior,” which is a type of data obtained by a process of intersubjective observation: One person or several persons evaluate a subject's behavior during an assumed baseline or altered state. This method has the deeply inherent limitation of not being able to access but only certain observable output domains of the subject's mental processes. Although observation supposedly eliminates the subjectivity and idiosyncratic interpretations of experiences on the subject's side, it replaces them with similar subjectivity and idiosyncratic interpretations of behavior on the observer side, burdened also with the problem of interjudge agreement in the case of several observers.

Thirdly, objective physiological measurements can yield a type of data related to the subject's mental processes. Assuming that changes in subjective experience are related to changes in brain processes, a wide range of technical instruments are available for measuring these neural correlates during baseline or altered consciousness. However, the exact nature of these mind–brain correlations is not well-known and is sometimes speculative. Nevertheless, it is suggested that neurophysiological measurements could provide data about the underlying constitutive mechanisms of phenomenal consciousness and not about the correlates of phenomenal content. Still, neurophysiological measurements can only confirm the occurrence of neural correlates of mental processes that have been previously or simultaneously described by the subject. Thus, in exploring ASC commonalities, neurophysiological measurements may not be primary, but only confirmatory and correlative sources of data.

Regardless of source type, all data can be compared (to previous data) in two basic ways. Within-subject comparisons can take into account individual parameters to find out differences between a baseline and one or several altered states of the same subject. Between-subject comparisons of the same state can average out individual and general parameters to reveal more state-specific typicalities. Both of these comparative directions are valid and may provide additional support for an otherwise assessed state being a certain ASC. Moreover, correlations between data from two or more different source types can be used to validate instruments against each other. For example, if a certain bundle of phenomenal patterns is defined to mark a certain altered state, then its systematically correlating neural patterns can be used also in another charting situation as a sufficiently reliable marker of that altered state, without a need for any further phenomenal charting in the second situation. However, there should be a warning against taking neurocognitive data as sole or primary evidence for consciousness alteration, especially in the between-subject comparison case. Considering the substantial individual variation in brain activity patterns, declaring an ASC for a subject is certainly unacceptable when the claim is only based on a comparison with neurocognitive data of other subjects. Neuroethical implications of externally retrieving information concerning a subject's state of consciousness are also to be taken seriously but nevertheless lie beyond the scope of this paper.

Alterations

In addition to the definition-based theoretical analysis performed above, another line of analysis could also be carried out on what an alteration technically means. Issues

such as temporal dynamics, mechanisms, and features of alteration are to be inspected in order to obtain a fuller view. For a proper integration of different data sources, it might be useful to embed the notion of alteration in a multilevel framework. In general, thinking in multilevel systems helps to understand natural, biological phenomena that are organized along a continuum on different scales and with different complexity. In the case of alterations, this approach could also help us in conceptualizing certain aspects of ASCs along with their larger context, namely the problem of consciousness. Such an approach is, for example, biological realism, which treats consciousness as the phenomenal level of organization in the brain (Revonsuo 2006). Still, regardless of any given theory, consciousness could be conceptualized as one undivided phenomenon that is accessible on several parallel levels of description (or explanation), each capturing different aspects by different inspection methods and concepts. Although levels of description in the mental and physical domains (the so-called mind–brain complex) are seemingly independent, the functions they describe are arranged in a certain hierarchy. Thus, levels could be ordered according to their scale, scope, and abstraction. Furthermore, these levels could be seen as dependent from each other by the principle of supervenience, i.e., the existence of higher levels is dependent on a certain minimal functioning of lower levels. The physically underlying, most basic level is the material implementation of neural mechanisms that are required for operating the brain machinery. Components of the neural level have the smallest scale in physical size, distance and power, and the most concrete spatial-structural location. In the information processing chain, this level operates the neurophysiological correlates on which cognitive mechanisms are built. The cognitive level is based on a functional grouping of neural mechanisms into subsystems that implement various aspects of mental operation. These subsystems are defined by abstract concepts of cognitive psychology, and some of their processes may potentially and/or partially be accessible for the subject to experience and report them as his/her mental functioning. In particular, temporary and reversible changes in the cognitive subsystems can be self-detected and described. The phenomenal level is about the ongoing first-person experience, which had been described and referred to as the stream of consciousness (James 1902), the what-is-it-like-to-be-something-or-someone feel (Nagel 1974), or as inner presence (Revonsuo 2006). This level is accessible exclusively by the subject, who is able to self-report some of his/her mental contents, processes, and states upon request. There are also other levels of description that may be relevant in the exploration of altered state phenomena. The behavioral level could provide data based on a person's distinct motor and verbal output by third-person observation. A personal level may be needed in charting biographical details and personality traits that may form the attitudes and expectations of the subject. Also, a social level might be of importance, as it defines the interpersonal aspects and cultural contexts of an alteration. However, for exploring the overall patterning of psychological functioning during ASCs, the self-mapping procedure does not need all available levels of description; thus, we may initially choose only the neural, cognitive, and phenomenal level (see also Mortimer and McKenna 1994).

As the very basic meaning of alteration simply denotes a process of change, we may find useful to inspect also its temporal dynamics. By looking at various consciousness alteration phenomena, it can be seen immediately that certain

parameters of this change process may greatly influence whether an alteration is considered as an ASC or not. As the above provided lists show, neither brief emotional changes (e.g., a burst of rage, a momentary panic reaction, a cry attack) nor slow personality alterations (e.g., becoming melancholic, falling in love, getting brainwashed) are generally counted as ASCs. Thus, there is a requirement for an ASC to be somewhat stable over a certain time period, although there are no further guidelines or definitions about generally acceptable minimal and maximal durations of this period. The notion of temporary stability also implies the criteria of transience: There should be both a stabilization process (i.e., the state should clearly last) and a destabilization process (i.e., the state should eventually end). An important implication of these transience criteria is that regardless of any typical characteristics of consciousness alteration, we cannot define it as a state until the alteration has actually ended. Thus, beginning (onset) and ending (fadeout) phases are not always clearly distinguishable from the main alteration (plateau) phase. During transitions into and out from a state, a mixed situation of "inertia" may occur, i.e., an overlap between previous and next state. Although greatly depending also on the induction method, inertia can be a very characteristic feature of an altered state or of a transition between two states.

In the classical ASC literature, alteration mechanisms are described by terms and models from cognitive psychology. According to Tart (1975), consciousness alteration results from a temporary destabilizing and repatterning activity on the individual's default pattern-making processes. This activity can be targeted at various structures of the body, brain, or mind, such as sensory modalities, movements and postures, breathing, brain metabolism, neurotransmitter levels, linguistic processing, emotions, etc. ASC inductions are thus bundles of methods that activate, deactivate, or modulate different structures in the mind-brain complex by stimulus overload, repetition, homogenization, and deprivation techniques. For example, a religious ceremony may incorporate all these four different types of stimulus manipulation techniques by utilizing abundant imagery, chanting, incense, and kneeling, respectively. Recent ASC models—especially since the 1990s decade of the brain—involve also neural correlates of consciousness in their explanations. For example, the three-dimensional Activation-Input-Modulation state space model is based on observed neurochemical changes in the brain, such as distinct alterations in neurotransmitter levels at certain locations in the prefrontal cortex (Hobson 2002). Another notable neural-level ASC model is based on the cortico-striato-thalamo-cortical (CSTC) loop hypothesis, which explains hallucinogen-induced consciousness alterations by disinhibitory mechanisms in serotonergic pathways between different brain areas (Vollenweider & Geyer 2001). The CSTC neural model is, by the way, elegantly supported by a systematic correspondence with the phenomenal experience during pharmacologically induced ASCs.

In spite of partially different terminology, there seems to be a common understanding of what the altering or changing features during ASCs are, as many authors of the above-cited definitions also share a similar approach from the cognitive sciences point of view. For example, Tart (1975) mentions ten subsystems: exteroception, interoception, input-processing, memory, sense of identity, emotions, evaluation and decision making, subconscious, motor output, and space/time sense. Farthing (1992) has a 14-item list about dimensions of conscious experience:

attention, perception, imagery and fantasy, inner speech, memory, higher-level thought processes, meaning or significance of experience, time experience, emotional feeling and expression, arousal, self-control, suggestibility, body image, and sense of personal identity. Similarly, Hobson (2007) enumerates nine mental elements (or capacities of mind or components of consciousness): perception, attention, memory, orientation, thought, narrative, instinct, intention, and volition. It is to be noted that these listed features are described on the cognitive level.

For a comprehensive mapping of different ASCs into a multidimensional state space, alterations of all these features should be specified in the descriptive data. Even more preferably, the data should be in quantifiable form, in order to be computable and comparable on numerical scales. Beside general psychological inventories, there are special psychometric assessments of altered consciousness, such as the widely used and standardized, originally German language *Aussergewöhnliche Psychische Zustände* questionnaire and its psychometrically tested translations in several other languages (Dittrich et al. 1985). For pharmacologically induced hallucinatory states, another useful questionnaire is the Hallucinogen Rating Scale, which was developed for N,N-dimethyltryptamine (DMT) human experiments (Strassman et al. 1994). While it would be optimal to obtain numerical results on the same scale(s) for all candidate hallucinatory ASCs, this can hardly be achieved due to practical limitations within the scopes of experimental research. Thus, it is suggested that for a numerical comparison, freeform first-person experience reports could be taken to quantification as the primary source of data.

Hallucinations

Regardless of opposing psychological or medical viewpoints on their continuity with normal experience (Aleman & Larøi 2008), hallucinations are generally considered as distinct signs or symptoms of ASCs. Thus, hallucinations are such fundamental changes in the core subjective experience that they indeed deserve to be focused on in ASC-related debates. Perception without a corresponding external stimulus is relatively common in the general population and may occur in any sensory modality. During wakefulness, hallucinations are most frequent in the olfactory (smell) and gustatory (taste) modalities and during sleep in the visual and auditory modalities (Aleman & Larøi 2008). Remarkably many types of hallucinatory phenomena are sleep-related: hypnagogic hallucinations while falling asleep, vivid dreaming during REM sleep, isolated dream images in NREM stages, and hypnopompic hallucinations while awakening (however, it is to be remarked that some definitions do exclude sleep-related phenomena from the category of hallucinations). Outside the sleep state, there are hypnotically suggested hallucinations, peduncular hallucinosis in the evening, hallucinations caused by sleep deprivation, and Purkinje hallucinations inducible by photic stimulation within a specific frequency and luminance range (ffytche 2008). Known hallucinogenic substances are the major psychedelics (e.g., LSD, DMT, mescaline, psilocybin, LSA, and salvinorin-A), deliriant plants (e.g., jimson weed, henbane, and mandrake), and dissociative drugs (e.g., ketamine, PCP, and DXM; Nichols 2004). Among others, pathological hallucinations are related to alcohol withdrawal symptoms (delirium tremens), schizophrenia, Parkin-

son's disease, Charles Bonnet syndrome, and focal epilepsy (Aleman & Larøi 2008). Hallucinations can be also classified by induction method or cause and different types seem to fit well into Vaitl's five categories (see above).

Definitions of hallucinations are as manifold as those of ASCs. Perhaps the most classical definition by Esquirol (1845/1965) states that: "A man... who has the inward conviction of a presently perceived sensation at a moment when no external capable of arousing this sensation is within the field of his sense, is in a state of hallucination." Similarly, Horowitz (1975) has a definition: "Hallucinations are images based on immediately internal sources of information which are appraised as if they came from immediately external sources of information." From a clinical viewpoint, the American Psychological Association defines hallucination as: "A false sensory perception that has a compelling sense of reality despite the absence of an external stimulus." (VandenBos 2007). As in the ASC definitions, it can be immediately noticed also here that subjective experience (i.e., the phenomenal level) is involved as a criterion. From these definitions, another three commonalities concerning the sensory domain, the external–internal distinction, and trueness of hallucinations are to be pointed out and analyzed next.

While the above definitions refer to sensation and perception, the scope of altered mental functioning during hallucinations is not at all limited only to the sensory domain but extends also to the cognitive domain. The division between changed sensory experience—defined as hallucinations—and changed cognitive experience—referred to as delusions—is not that sharp at all. There is a pronounced overlapping between thoughts and images, especially when involving less sensory-driven mental content. In closed eye cases of fantasy, imagination and visualization, thoughts may trigger internal images in the mind's eye. Vice versa, visual percepts and visions may start up associative chains of thought. Thus, while accepting the importance of changed perception in the sensory domain, definitions of hallucination should also involve descriptions of experience in other domains, such as the cognitive one. Alterations in metacognitive processes—such as derealization, depersonalization, or loss of insight—are essential in telling apart hallucinations from pseudohallucinations. Optimally, hallucinatory altered states of consciousness should be assessed with respect to all mental subsystems that may change during an ASC.

It can be also seen above that several definitions make a clear separation between the external and the internal, referring to causal mechanisms of sensory information processing. Even though a distinction between external and internal seems to be appropriate and justified in the context of alterations, details concerning their relationship are crucially important in conceptualizing hallucinations. Admittedly, this relationship is also a core issue in the philosophy of perception and cannot be explored here in sufficient detail; hence, only a couple of relevant thoughts are to be pointed out here. An important step in clarifying this issue could be to accept that external and internal are not alternatives to each other in the sense of an exclusive "or" relationship. While both of them can be pointed out as primary sources of information, they are not independent from each other. Rather, they could be thought about as consecutive stages in the information processing mechanisms, as external information is always processed internally. Furthermore, it is commonly accepted that exteroception is fundamentally modulated by internal processes, such as

attention, memory, and emotion. These processes are already involved in selecting data from immediately external sources, as well as in later stages of input-processing. Thus, it is not the source of information per se but the modulating information processing mechanisms that may make a crucial difference. Due to these mechanisms, appropriate stimuli may open up “phenomenal windows” (Revonsuo 2006) that are subjectively experienced—regardless of the original source of information that caused their appearance.

Last, we should also take a quick look at the notions of “trueness” and “reality” of hallucinations from a merely linguistic point of view. According to Tart's original notion, the word “altered” is intended as a purely descriptive term, carrying no values (Tart 1975). However, it is to be noticed that many definitions, descriptions, and accounts of both ASC and hallucinations include negative value-judging terminology that may even lead to the social dismissal of the phenomena (Shanon 2003). Adjectives like abnormal, inaccurate, unreal, false, misrepresented, and erroneous suggest the inferiority of the altered phenomena, as compared to a normal, accurate, real, true, objective, and proper baseline. When definitions of these terms are taken to a dictionary-based analysis (Merriam-Webster, suppressed from here), it is revealed that definitions of the above terms are referring to each other as well as some more terms, such as wrong, existence, fact, appearance, claim, precise, correct, and standard. In turn, looking up the definitions for these terms yields even more new terms, such as observation, experience, deviant, ordinary, sane, typical, bad, and inappropriate. Beside mutual references and circular loops, it can be concluded that words in the above definitions fall roughly into three categories. Perceptual notions are mainly associated with appearance, observation, and impression, thus related to the subjective and intersubjective domain. Cultural notions relate mainly to interpretations, declarations, and social norms, thus based on subjectivity, consensus, relativism, and constructivism. Statistical notions describe similarities and differences between elements in predefined data classes, thus refer to results of numerically computable comparisons. From these three categories, only statistical notions can be considered objective enough to be used in a computational procedure, i.e., in a numerical comparison of quantified data. Therefore, it is suggested that concerning hallucinations and ASC, definitions by statistical notions should be preferred over perceptually and culturally biased notions.

Conclusions

Based on the technical analysis above, the following working definition can be concluded: “A hallucinatory altered state of consciousness is a transiently stable mode of operation on supervenient levels in the mind–brain complex, where objectively detectable characteristic changes in the internal information processing mechanisms of neurocognitive subsystems may be subjectively experienced as changes in phenomenal content and overall psychological functioning, as compared with prior and posterior baseline states of the individual.” This technical conceptualization may serve as a proper basis for a future systematic comparison of ASCs. A proposed stepwise operationalization procedure of this comparison would be the following: (1) Compile a list of ASC candidate phenomena: To start

the procedure, instead of definitive ASC listings, it is only needed to compile a comprehensive and inclusive list of all phenomena that are commonly regarded or can be possibly considered as ASCs. (2) Compile a list of mental subsystems: For this, any literature-based list (with optional modifications) could suffice. (3) Find, categorize, and quantify references to alterations of each mental subsystem in first-person reports describing subjective experience: Characteristic alterations of consciousness for each ASC candidate phenomenon should be evaluated by multiple criteria concerning different aspects (or dimensions) of the alteration. As a working hypothesis, it is proposed that the regarded phenomena should not be classified dichotomously (as either ASC or non-ASC) but that all ASC candidates should be aligned on a continuum in each dimension. At its simplest, single "ASCness factors" can be understood as relative values on a one-dimensional scale. (4) Compute distances from median values in each dimension for each ASC candidate: For each dimension, lower and upper boundaries can be set to separate final inclusions (ASCs) and exclusions (non-ASCs). (5) Compute multidimensional distances: By averaging one-dimensional distances for each ASC candidate, substantially similar phenomena will be located at close proximity to each other, forming an ASC core. Respectively, less typical ASC candidate phenomena will reside at more distant locations toward the edges of the map. (6) Describe the core ASC typicalities: After completing the self-mapping procedure, a description properly capturing the most characteristic properties of the yielded core ASC phenomena could serve as a proper definition of ASC.

After obtaining a phenomenal map of ASCs, the self-mapping procedure could be repeated with systematically categorized and quantified cognitive and neural data sets as well. Comparing and exploring similarities and differences between the maps may shed light on correlations—and perhaps even on biconditional relations—between these three levels of description in the mind–brain complex. However, as exciting as this may sound even from the perspective of the Hard Problem of consciousness, such an exploratory project remains yet to be designed and carried out in the future.

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