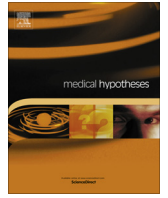




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## Epistemological implications of near-death experiences and other non-ordinary mental expressions: Moving beyond the concept of altered state of consciousness

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### ABSTRACT

During the last decades an increasing interest has developed in the so-called altered state of consciousness (ASCs); among these, near-death experiences (NDEs) are one of the most intriguing and debated examples. NDEs are deep and universal experiences with a clear phenomenology and incidence, while some of their features challenge the current views of human consciousness (focused on neural circuits and based on the concept of mind as a byproduct of brain circuitry) with relevant epistemological and historical implications.

The origin of the ruling mechanist–reductionist paradigm can be traced back to Descartes' radical separation of *res cogitans* and *res extensa* and the conflict between the nascent science and the Inquisition; this led to removing the subjective properties of mind from the field of scientific interest, relegating them to philosophy and theology in order to enable the development of modern science. However, the physics of the 20th century has eventually moved beyond the classical paradigm, permitting a profound renewal of scientific interest in the mind.

Modern research on NDEs has contributed to reopening the debate surrounding the Cartesian separation, the mind–brain relationship and the nature of consciousness. It is now time to reappraise the relevance, strengths, and weaknesses of the available scientific interpretations of NDEs, their relationship with other ASCs, as well as the very concept of ASC; the latter looks to be ill-founded, suggesting the need for: (a) a revision of the conventional approach to subjective phenomena, including both the third- and first-person perspective; and (b) a deep reflection on the possible links between different non-ordinary mental expression, as regards both their phenomenology and mechanisms from a non-pathological perspective.

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### Introduction

The term “altered state of consciousness” was coined by Ludwig, who first defined it, as “any mental state representing a sufficient deviation in subjective experience or psychological functioning from alert, waking consciousness” ([1] p. 225). To date, the classification of altered state of consciousness (ASCs) includes a wide range of experiences, including coma, persistent vegetative state, delirium and hallucinations. Within the wide range of ASCs, near death experiences (NDEs) represent one of the most

investigated phenomena in the last three decades. Indeed NDEs invite important scientific, philosophical and religious reflections and their nature represents a true challenge for modern neuroscientists.

NDEs are subjective experiences with transcendent tone that occur in critical conditions, usually associated with loss of consciousness, such as in cardiac arrest, head injury, or states of shock. They are often characterized by the clear perception of being in a different dimension, of having left the physical body, and of being in a different spatio-temporal dimension (see Table 1 for a list of the main recurring features). Even though some cross-cultural differences in some recurring features have been described, overall the reports show sufficient common features around the world to be considered a universal human experience, making the

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**Table 1**  
Main recurring features of NDEs with examples of their narration.

1	<b>Awareness of being dead</b> (e.g., Dell’Olio, 2010; Morse et al., 1986; van Lommel et al., 2001) <i>“I realized that I was dead...”</i>
2	<b>Feeling of pleasure, euphoria, well-being</b> (e.g., Blackmore, 1996; Dell’Olio, 2010; Greyson, 2010) <i>“...However I wasn’t sad or sore, I felt elated and surrounded by a sense of joy...”</i>
3	<b>Out-of-body experience</b> (e.g., Greyson, 2010; Kelly, 2001; Morse et al., 1986; van Lommel et al., 2001) <i>“...I could see medical personnel working on me, but I saw it from a new perspective. It was as if I were the director of the scene, not the actor...”</i>
4	<b>Tunnel-like perception</b> (e.g., van Lommel et al., 2001; Kelly, 2001; Blackmore, 1993; Dell’Olio, 2010; Kellehear, 1993) <i>“...Then I saw a dark tunnel in front of me, I couldn’t figure out where to bring and what there was at the end of it...”</i>
5	<b>Perception of a bright light</b> (e.g., Kelly, 2001; Ring and Cooper, 1997; van Lommel et al., 2001) <i>“... There was a light in front of me, whose glow I had never seen before...”</i>
6	<b>Perception of heavenly or hellish environment</b> (e.g., Greyson and Bush, 1992; van Lommel et al., 2001) <i>“... Everything around it was like I had imagined, I knew I was going to heaven...”</i>
7	<b>Vision of deceased persons, religious figures or undefined entity</b> (e.g., Betty, 2006; Greyson and Stevenson, 1980; Greyson, 2010; Kelly, 2001) <i>“... suddenly I saw a human silhouette, an indefinite presence...”</i>
8	<b>Life review</b> (e.g., Stevenson and Cook, 1995; Greyson, 2010; Kellehear, 1993) <i>“...I began to review my whole life, a series of flashbacks that I couldn’t control. It was as if I saw them through the window of a train...”</i>
9	<b>Different time perception</b> (e.g., Greyson and Stevenson, 1980; Greyson, 1998) <i>“...I felt in a timeless environment. I could have stayed there one minute or one day, I don’t know”</i>
10	<b>Perception of sounds and music</b> (e.g., Greyson and Stevenson, 1980; Ring and Franklin, 1981) <i>“... And there were sounds, celestial melodies that I wouldn’t easily define...”</i>

phenomenon of interest for modern neuroscience [2,3]. The incidence of NDEs is relatively high, being in the range of 10–18% of patients in critical condition [4–7], showing that they are a reproducible clinical phenomenon with clear clinical epidemiology rather than a sporadic event. The exact incidence is unknown because NDE accounts are usually not collected by the medical staff, while many patients prefer not to report their experiences, or decide to describe them exclusively to doctors who are familiar with this issue, to avoid to be considered still highly confused following the injury [8]. As claimed by Auxéméry [9], the increasing number of NDE cases, as well as the dilemma of possible persistence of residual consciousness in comatose and vegetative patients (see [10] for a review), urges one to re-think the interaction of medical teams with seemingly unconscious patients: they should not act as these patients were not there, but, conversely, as subjects (despite non-communicating) to whom one speaks.

### Scientific interpretations of NDEs

In recent years several psychobiological interpretations have been proposed, but none of them has been proved so far, while some of them are contradicted by the available data (see [11], as a review). For instance, it was suggested that retinal ischemia might explain the tunnel-like vision [12]. Since endogenous opioids are released under stress (e.g., during hemorrhagic shock) they have been postulated as a potential reason for the positive emotional tone of NDEs. Likewise, the excitotoxic brain damage yielded by uncontrolled glutamate release in acute brain damages led to speculation about its role in NDE origins, stimulating the release of a ketamine-like neurotoxin as a trigger of NDEs [13,14]. Recently Bokkon et al. [15,16] argued that the perception

of brilliant lights (one of the most recurring features of NDEs) might be due to the unregulated production of free radicals and excited biomolecules in the visual system released after the traumatic event. This would produce bioluminescent photons and generate phosphenes (the perception of flash of lights in absence of external visual stimulation), hence giving the impression of a bright light whose glow was seldom seen before in everyday life.

Other authors stressed the potential role of NMDA receptors [17], the temporo-parietal cortex, or REM-sleep intrusions and sleep paralysis associated with hypnagogic and hypnopompic experiences [12,18–21]. A recent psychophysiological study in rats showed that for 30 s after cardiac arrest rat brains can surprisingly generate neural correlates that the authors claimed resembled those commonly reported in heightened conscious processing [22], which the authors suggested might explain the highly lucid experiences reported by near-death experiencers.

Psychological interpretations of NDEs have also been proposed, mainly related to the “expectancy hypothesis”, according to which NDEs are the product of altered mental states precipitated by life-threatening conditions, which trigger NDE phenomenology as a projection of beliefs and expectancy of the afterlife. According to this hypothesis, in the face of declining sensory information, our brains recruit a projective defense mechanism to make the new reality more intelligible and less distressing [8,23].

The above mentioned hypotheses have undoubtedly helped us to form a broader comprehension of this issue; however, each of them remains an hypothesis far from being demonstrated [11], while some of them are not even well-founded. For example, the idea that retinal ischemia might trigger tunnel vision is not sustainable for several reasons: (a) in coma due to traumatic events there is no vascular ischemia of the retina; (b) in post-anoxic coma, as in cardiac arrest, the loss of consciousness is too sudden to permit patients to develop complex tunnel-like perception; (c) retinal ischemia in hemodynamic syncope does not cause tunnel vision; (d) centripetal ischemia of the retina, such as in military pilots flying at G-force acceleration, can create a circular narrowing of the visual field, but not a clear perception of a tunnel-like structure.

As far as opioids are concerned, they are not hallucinogenic in patients to whom they are administered for analgesia, and their psychotropic effects show a completely different phenomenology than NDEs. Hallucinogens do not produce experiences similar to NDE, unless they are used in the context of a clear purpose and a well-controlled ritual, such as the use of iboga in the Bwiti religion [3,11]; and even in those cases, the participants do not experience being in another world but continue to communicate verbally to those around them throughout the ritual [24].

Against the expectancy hypothesis are the facts that individuals often report experiences that conflict with their expectations regarding death. Prior knowledge about NDEs does not seem to influence the reported details of the experience; NDEs reported prior to 1975, when the term “near-death experience” was coined and the phenomenon first described, do not differ substantially from NDEs reported today. Furthermore, young children, who have fewer cultural and religious beliefs about death, report the same characteristic features of NDEs as do adults [25–27]. Strictly related to the hypothesis of NDEs as ‘false’ memories, a recent study recorded electroencephalographic activity under hypnosis (which is supposed to increase the amount of details in the recall) in participants who had a NDE in the past. The pattern of EEG during the recall of imagined events was significantly different from the one observed when recalling their NDEs. More specifically, NDE memories were linked to theta band, a well-known marker of true episodic memory, suggesting that NDE memories cannot be simply considered as memories of imagined events [28].

The involvement of the temporal lobe in the NDE remains only a speculation far from being demonstrated, since the conjecture

linking NDEs to temporal lobe epilepsy is not supported by clinical evidence. Rodin summarized their purported similarity unequivocally: “In spite of having seen hundreds of patients with temporal lobe seizures during three decades of professional life, I have never come across that symptomatology [of NDEs] as part of a seizure” [29]. An EEG study of near-death experiencers found “no clinically significant seizure activity (EEG or tonic-clonic posturing)” [20]: that study did report *subclinical* temporal lobe activation not suggestive of seizures in 5 of 23 near-death experiencers, but nearly 80% of the experiencers had no such unusual EEG activity.

Electrical stimulation of the temporal lobe can elicit fragmentary bits of music or voices, seeing isolated and repetitive scenes, fear or other negative emotions, or bizarrely distorted dreamlike imagery that are quite unlike coherent NDEs ([30,31] pp. 611–665). Temporal lobe stimulation can also induce somatic illusions that have been erroneously described as “out-of-body experiences,” but unlike NDEs, these illusions do not include perception from a visual perspective away from the body, do not include corroborated perceptions of objects not visible from the physical body, and disappear when the eyes are closed [32,33]. In addition, a study comparing the reports of out-of-body experiences of patients with EEG evidence of their seizure focus did not find differentiating EEG or other physiological traits that were associated with patients’ reports of out-of-body experiences, suggesting that we are far from having grasped the neurophysiological factors underlying this feature of NDEs [34].

Brain imaging with fMRI and EEG of near-death experiencers attempting to visualize and reconnect emotionally with their NDEs showed significant activation in the right brainstem, right lateral orbitofrontal cortex, right medial prefrontal cortex, right superior parietal lobule, left superior occipital gyrus, left anterior temporal pole, left inferior temporal gyrus, left anterior insula, left parahippocampal gyrus, and left substantia nigra, and increased theta power in a wide variety of loci [35]. These findings support recent clinical and neuroimaging research suggesting a much more complex picture of related mystical experience involving not just the temporal lobes but extensive neocortical involvement [36–38].

The hypothesis that NDEs are related to REM intrusion is not compatible with cardiac arrest, a condition in which brain electrical activity is silent, nor with the typical occurrence of NDEs under conditions that inhibit REM, such as general anesthesia [39]. The discovery that rats’ brains have neurophysiological activity for 30 s after cardiac arrest is surely worth noting for a better comprehension of the neural processes underlying brain death in mammals [22]; but claiming that NDEs can be explained by this neural activity is unwarranted. First, despite remarkable similarities in mammals’ brain, rat brains are not human brains, and studies of human brain activity after cardiac arrest show brain activity decreasing and terminating within 6–7 s without any surge [8]. Furthermore, the neural surges reported in rats were obliterated by anesthesia, which does not dampen NDEs, and the transient electrical surges were a tiny fraction of the power of the cerebral electrical activity in the rats prior to cardiac arrest [27]. And of course, there is no way to assess whether rats (or other animals) may have any NDE-like experience associated with specific neural activity.

More generally, statistical correlations of mental and biological processes do not imply that the former totally derive from the latter and do not prove any causal relationship between the two. The movement of our legs is essential to walking, but that does not imply that our intent to walk originates in our legs. The movement of our legs is the *proximate* cause of our walking, but not the *ultimate* cause. Likewise, neural networks may be necessary for mental phenomena, but this neither proves nor disproves that mental activity originates in the brain or is a mere epiphenomenon of brain circuits. Mental activity that has biological preconditions is

not necessarily reducible to those biological conditions [40]. Jansen, who popularized the ketamine model of NDEs, after several more years of research eventually came to regard ketamine not as causing NDEs but rather as rendering them more accessible: “Ketamine is a door to a place we cannot normally get to; it is definitely not evidence that such a place does not exist” ([41], p. 95).

In summary, the idea that NDEs are the mere result of brain dysfunction is based on speculation rather than on evidence, speculation that often denies the facts incompatible with the reductionist vision. A recent large-scale study clearly documented that a patient had a verifiable conscious awareness lasting no less than three minutes during cardiac arrest [6], where the recalled experience of the events occurring in the resuscitation room was verified by the hospital staff. Although rare, this is not a unique example of a veridical out-of-body experience: another case was reported in a rigorous multicenter prospective study by van Lommel et al. [7], while two other cases were described in two books by Sabom [42] and Hamilton [43], respectively. These facts cannot be disregarded just for their rarity or ostensible incompatibility with the current view of the body–mind interaction. It is worth emphasizing that the problem is epistemological in nature, but is not the result of reductionism in itself, which remains a powerful investigative tool; rather, the problem is the possible misuse or abuse of reductionism, leading to the exclusion a priori of what is not compatible with widely accepted axioms: this would inescapably lead to a dogmatic drift, a sort of methodolatry or theology of the paradigm.

On the whole, NDEs, physically and clinically lying at the boundary between life and death, physics and metaphysics, represent one of the great challenges to the reductionist materialist paradigm. In other words, they call for reappraising the conventional view shared by both science and common sense, i.e., the belief that the mind can passively gain objective knowledge only through information driven by sense organs in the three dimensional space of the external world, along linear time. In other words, one should reappraise the very foundation of what is believed to be “real”, and why NDEs were a priori considered illusory or false in the past.

NDEs allow for an insight into the phenomenology, origin, and structure of consciousness and mind through the Non-Ordinary Mental Expressions (NOMEs) perspective, which involves the still mysterious relationship between the inner and outer world and cannot be reduced to the limits of a simple axiomatic definition. In this context, Ray’s hypothesis of mental organs and their neurotransmitters (the families of monoamines, opioid, cannabinoid, and imidazoline receptors) has provided a new appealing conceptual framework for redefining consciousness, mind and NOMEs, integrating the third person perspective (3PP) and the first person perspective (1PP) [44]. According to this perspective, sensations and feelings may enter consciousness only passing through the gate mediated by serotonin-2 and cannabinoid receptors, which behave like powerful filters. If so, the most energetic mental organs, including the gatekeeper to consciousness (serotonin-2), are likely to be the first to lose function in critical conditions (physical or existential), allowing for an enhancement of consciousness and emergence of NDEs and other NOMEs, with their inescapable meaning. This hypothesis is intriguing, since it lets one also start perceiving NOMEs as a possible positive phenomenon, an issue worth of being addressed in the future. In fact, the attenuation of the filter may not only yield a dysfunctional, less-than-normal, or less-valuable condition: indeed, it might really enhance and improve consciousness, when a too selective filter prevents the access of relevant elements of cognition, i.e., when the filter is set with a too narrow band pass in the communication with inner and/or outer worlds.

As already mentioned, NDEs have been included in the topic of so-called ASCs [45]. The term “altered” may mean either modified,

different, or disordered. Some ASCs indicate pathology, such as psychosis or intoxication. Others, although different from our normal waking consciousness, are not only normal but adaptive and necessary for survival, such as sleep. Still others indicate enhanced mental functioning, such as the hyperalertness and intense focus of athletes “in the zone” (see Table 2). This ambiguity regarding whether an ASC is merely different from normal consciousness or disordered has proven to be problematic. When applied to non-pathological phenomena, it may semantically suggest the idea of dysfunction; this air of abnormality, or at least of a less-than-normal condition, may be implicitly reinforced when non-pathological states of consciousness are lumped together with pathological ones, like in the ASC classification reported by Vaitl et al. [45]. If so, a term such as NOME may be preferable to indicate these complex mental processes, which differ from ordinary ones but still belong to the field of “normality”: they may include the most mysterious functions and/or higher expressions of the mind, such as meditation, transcendent experiences, hypnosis, creativity, and spirituality. They overlap with anomalous experiences, which are non-pathological uncommon experiences shared by a significant number of persons, with strong cultural implications [46].

Table 2 may initially seem like an awkward collection of disparate items to scholars of unusual phenomena, and the choice of which of these phenomena to classify as “spiritual/religious or parapsychological” is a matter of opinion and open to legitimate debate. However, for a full comprehension of the issue it is necessary to catalog the variety of ASCs without scientific prejudice, in order to delineate the potential relationships among apparently disparate expressions of the mind. For those experiences encompassed by the term “paranormal”, an accurate estimation of both the reality and the frequency of such events is complex, given the difficulty of disentangling real events from fraudulent or imagined ones. However, it is worth noting that those experiences considered paranormal must only be either true or false: if they are false they should be rejected; if true their meaning and mechanism should be understood. This might involve the discovery of still unknown laws of nature. As a consequence, labeling a fact as

“parapsychological” and rejecting it without investigation appears to be a mere reflection of a cultural bias [46].

### Historical roots and epistemological implications of the issue

Secular scientific thought has generally disregarded phenomena with a flavor of spirituality or religion and ignored philosophical/religious problems, since they have been considered beyond the boundaries of the positivist view of physical reality. This has led, perhaps unwittingly, to considering such phenomena a priori as irrelevant or unreal, rather than simply beyond the current interests and techniques of scientific investigation. Such an attitude, the prejudicial nature of which is contrary to the very concept of science, has deep historical roots, dating back to Galileo and the conflict between modern science and the Inquisition. We suggest that this prejudicial attitude stems from a sort of “original sin” of modern science. This is the central hypothesis of this paper, leading to consider the need for reappraising our ruling paradigm from its foundation, especially when subjective phenomena are to be investigated. The authors are aware that hypothesizing an original sin in science may seem provocative and may easily give rise to possible misunderstandings, a risk calling for a clarification. This paper, dealing with the boundaries between life and death and their related experiences, must include consideration of the sensitive area where science, religion, and philosophy converge, engaging the limitations introduced by their historical clash and consequent separation. The authors wish to clarify that: (a) they endorse and adhere to the methods of science and do not have any a priori faith, belief or stance affecting their analysis; (b) the analysis has been conducted from a neutral point of view, a truly skeptical one, where nothing is to be either accepted or rejected a priori; and (c) indeed, their analysis starts from the Galileo’s method of “*sensate esperienze*” (“*sensible experiences*”), i.e. observation of facts, looking for the “*necessarie dimostrazioni*” (“*necessary demonstrations*”). Nevertheless, the inescapable epistemological implications of NDEs and NOMEs calls for a reflection on the very nature and validity of accepted axioms, in order to avoid hidden

**Table 2**

Main altered states of consciousness (ASC), spontaneous or induced, and potential ways to trigger them: many of these are not pathological conditions and represent Non Ordinary Mental Expressions (NOME), needing to be reappraised in term of physiological states.

<p>ASC</p> <ul style="list-style-type: none"> <li>• Coma</li> <li>• Delirium</li> <li>• Depersonalization and derealization</li> <li>• Seizure</li> <li>• Hallucinations</li> <li>• Hallucinogenic experiences</li> <li>• Hypnagogic states</li> <li>• Hypnosis</li> <li>• Lucid dream</li> <li>• Deep meditative state</li> <li>• Minimal responsiveness</li> <li>• Near-death experiences</li> <li>• Out-of-body experiences</li> <li>• Persistent vegetative state</li> <li>• Sleep and dream</li> </ul> <p>Potential triggers</p> <ul style="list-style-type: none"> <li>• Ascetic practices (e.g., Kelly and Grosso, 2007)</li> <li>• Dance (e.g., Grof, 1976)</li> <li>• Deprivation and sensory overload (e.g., Ludwig and Stark, 1973)</li> <li>• Existential crises (e.g., Facco and Agrillo, 2012b)</li> <li>• Extreme environmental conditions (Brugger et al., 1999)</li> <li>• Fasting (e.g., Huon and Brown, 1996)</li> <li>• Hypnosis (e.g., Facco, 2012)</li> <li>• Isolation (e.g., Suedfeld, 1980)</li> </ul>	<ul style="list-style-type: none"> <li>• Spiritual/religious or parapsychological experiences:               <ul style="list-style-type: none"> <li>o clairvoyance</li> <li>o mystical experiences</li> <li>o unexplained healings</li> <li>o extrasensory perceptions</li> <li>o reminiscence of previous lives</li> <li>o retrocognition</li> <li>o stigmata</li> <li>o telepathy</li> <li>o xenoglossy</li> </ul> </li> <li>• Perception of alien abduction</li> <li>• Stupor</li> <li>• Synaesthesia</li> </ul> <ul style="list-style-type: none"> <li>• Music (e.g., Lowis, 1998)</li> <li>• Meditation (Shapiro and Giber, 1978)</li> <li>• Orgasm (Mosovich, and Tallafarro, 1954)</li> <li>• Prayer (Goodman, 1986)</li> <li>• Psychotropic substances (Strassman, 2001)</li> <li>• Relaxation (e.g., Jacobs et al., 1996)</li> <li>• Respiratory maneuvers (e.g., Grof, 1976)</li> <li>• Rituals (e.g., Strubelt and Maas, 2008)</li> </ul>
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sources of bias, i.e., conclusions based on axioms, the truth of which is not warranted (see below). This calls for shortly outlining the birth and the history of modern science and validity of accepted axioms, a very complex topic, which has been discussed in detail elsewhere ([3], pp. 155–76; [47], pp. 337–98).

### History

Galileo, tried by the Inquisition in 1633, forced into abjuration, and sentenced to house arrest until his death, wrote the “*Dialogue concerning the two new sciences*” in which he delineated the position that the new sciences were not to invade the field of theology, but to eschew consideration of phenomena involving theological mystery (they should only limit themselves to deal with the “rough matter”). By demarcating a clear border between science and religion, Galileo saved both the Church and himself. Although this expedient boundary was entirely alien to the pursuit of knowledge, nonetheless it influenced the subsequent development of science for centuries.

Approximately in the same years, Descartes with his radical separation between *res extensa* – phenomena that are extended in space – and *res cogitans* – phenomena that are purely mental, made the realm of the mind immune from physical and mathematical models: in the *Meditationes de Prima Philosophia* (VI meditation) he stated that “. . . I am a thinking thing. . . my essence consists in that only. . . that I may exist without it [my body; authors’ note]”. That way, he both saved the soul, but excluded it (i.e., Ego and consciousness) from the approach of the nascent science; at the same time he favoured the birth of scientific medicine, allowing for its development safe from any interference of religion. As a result, the new science removed the observer from the observed world of classical physics and confined medical science to the material body-machine, erecting an impermeable wall between mind and body. Only the body-machine could be scientifically studied, while psyche and consciousness were relegated to philosophy and religion for centuries, as if the mind played no role in either physiology or pathology. Consciousness and mind were therefore excluded a priori from the emerging modern science more as a result of a political compromise with the Church (and forced by the Inquisition), than of a free epistemological reflection. Since then, mind and consciousness have been considered as vague philosophico-religious matters, inaccessible to the concrete scientific method.

It is worth noting that Descartes was strongly concerned with avoiding a conflict with Scholastics and the Church, and this may have led him to introduce (perhaps intentionally) some circular reasoning to demonstrate the existence of God and the soul (i.e., the fact that God is perfect and, thus, not a deceiver: as a result, clear and distinct ideas are true. In turn, given that clear ideas are true, the idea of God shows His existence). In other words, his thought enabled a soft and keen introduction of the mechanistic and quantitative principles of modern science by including some flaws, which may persist when they are uncritically accepted as new axioms or truths. As a matter of fact, several flaws can be perceived in Descartes’ thought, like the problematic, absolute separation between mind and body (affecting the understanding of the mind-brain-body relationship as well as psychosomatic disorders), or mistaking the ego for the soul (Descartes’ errors have been already analyzed in detail elsewhere by Damasio [48] and Facco [47]). The possibility that at least some of Descartes’ flaws were intentional and reflected his wish to introduce new revolutionary concepts, while avoiding breaches with Scholastics, can be drawn from his gravestone, where he wanted the following Latin sentence to be carved: “*Bene qui latuit, bene vixit*” (“He lived well who concealed well”; Ovid, *Tristia* III, 4, 25).

Here, the value of the scientific method and the genius of both Galileo and Descartes are not in discussion; the problem regards

only the risk of flaws introduced by some modern scientists, when uncritically accepting statements and axioms and/or a priori refusing whatever acquires the scent of transcendence, a stance well painted by Albert Einstein as follows: “*The fanatical atheists are like slaves who are still feeling the weight of their chains which they have thrown off after hard struggle. They are creatures who – in their grudge against traditional religion as the ‘opium of the masses – cannot hear the music of the spheres’*” ([49], p. 390).

### Epistemological implications

The risk of uncritically regarding as dogma the statements of great thinkers began with Aristotle’s disciples and seems to be a common inclination. According to Bertrand Russell’s criticism [50], his followers turned his philosophy into a sort of undisputed, dogmatic doctrine. Aristotle himself in both *Metaphysics* (1005B, 1–5) and *Posterior Analytics* (quoted in *Metaphysics*) warned against the uncritical use of axioms, which are, by definition, undemonstrated: the “philosopher” is to check their validity, while the “surveyor”, unaware of their limits, only applies them. Therefore, one must be aware of the risk of imposing doctrines and dogmas of whatsoever origin (stemming either from a given formal religion or from secular axioms and paradigms) in the contemplation and investigation of nature. Just the opposite, the highest virtue of science is the capability to check and change its axioms and paradigms, and to question even accepted models when they prove incompatible with facts; indeed, this is what Einstein and quantum physicists did in early 20th century, sparking a scientific revolution.

The separation between the scientific and the spiritual persisted over centuries and was codified in 1997 by Gould [51], who reappraised the principle of “*nonoverlapping magisteria*”, introduced by Pope Pius XII in his encyclical *Humani Generis* (1950), and Pope John Paul II’s proclamation of October 1996. Gould suggested that science and religion can never be in conflict because of “*a lack of overlap between their respective domains of professional expertise – science in the empirical constitution of the universe, and religion in the search for proper ethical values and the spiritual meaning of our lives. . . Each subject [science and religion; authors’ note] has a legitimate magisterium, or domain of teaching authority – and these magisteria do not overlap (the principle that I would like to designate as NOMA, or ‘nonoverlapping magisteria’). The net of science covers the empirical universe: what it is made of (fact) and why does it work this way (theory). The net of religion extends over questions of moral meaning and value. These two magisteria do not overlap*”.

The National Academy of Sciences of the USA adopted this distinction in a 1998 statement: “*Many scientists are deeply religious. But science and religion occupy two separate realms of human experience. Demanding that they be combined detracts from the glory of each*” [52].

The above mentioned principles, although practical for some purposes, do not resolve the problems rising in the joint border and areas of convergence of science and religion, and seem to be still conditioned by the radical dualism of our culture (of which Descartes is the cutting edge): these assumptions still appear to be inescapably axiomatic, stemming from the classic, dualistic separation of body and mind, physics and metaphysics, with their limits and implicit logical contradictions.

In fact, if we accept the idea of modern neuroscience that every mental activity has neural correlates, then we can no longer justify scientific neglect of mental phenomena including spirituality and transcendence, which must also have researchable neurophysiology. Gould himself acknowledged that his principle of nonoverlapping magisteria is not “*all neat and clean. . . In fact, the two magisteria bump right up against each other, interdigitating in wondrously complex ways along their joint border. Many of our deepest*

questions call upon aspects of both for different parts of a full answer” [51].

All NOMEs must have neural correlates, even those currently inexplicable in terms of our current knowledge; otherwise the central axiom of materialist neuroscience, i.e. that any mental activity has its own neurocorrelates, would not be met [53]. However, when such phenomena appear inconsistent with accepted theories and known laws of nature, and/or involve profound philosophical and epistemological implications, they are likely to be rejected a priori or be constrained within the framework of the adopted paradigm (this is the case of NDEs and the recently reported veridical OBEs): doing this, scientists behave like Aristotelian surveyors. This may in turn lead to a dogmatic drift, where accepted scientific axioms and paradigms are prejudicially taken for truth, thus contradicting the very nature of science.

In short, science as a whole lies far beyond the limit of single axioms and paradigms, while its very history is a beautiful story of self-correcting revisions and revolutions. Here, we feel the duty to raise a doubt about the epistemological consistency of the classical medical mechanistic and physicalistic approach to subjective phenomena, especially the so-called ASCs. As such, it is not a matter of rejecting the validity of the current materialist-reductionist stance of science; rather, it is a hypothesis that may have reached its possible limits, when approaching subjective phenomena and topics apparently challenging accepted theories and axioms, just as Newtonian physics eventually reached its limits when analyzing subatomic phenomena and extreme velocities [22].

According to Popper, science is demarcated from pseudoscience by the potential falsifiability and the hypothetical nature of its statements [54]. The probabilistic nature of scientific truth necessarily requires the use of statistical analyses for any scientific statement, and statistics has indeed become an essential tool to test hypotheses. However, the very concept of normality (as a byproduct of statistics) has been reduced to terms of prevalence.

Even though scientists analyze classical physical phenomena in measurable and quantitative ways, some fundamental human phenomena cannot be understood without taking into account their subjective nature and their meaning “from the inside”. In contrast, the reductionist approach to consciousness and ASCs tends to consider as abnormal certain non-pathological phenomena solely because they appear strange; or reductionists may even refuse to consider some non-pathological phenomenon because they appear incompatible with the dominant paradigm. Contemporary medicine and psychiatry have an inherent bias against focusing on the subjective (rather than objective) components of mental illness, which ironically are precisely those aspects that define psychiatry as a profession [40].

One must be aware that belief and dogmatism are not associated only with religion, but are a universal habit of the human mind, to which scientists are not immune. The history of science and its revolutions, well-described by Kuhn [55], is a clear demonstration of how scientists’ beliefs may undermine the perception of reality itself, requiring a remarkable effort to overcome them. Furthermore, at the end of the 19th century positivism proclaimed the superiority of scientific knowledge with respect to any other form of knowledge: in the perspective of logical positivism only what can be observed and checked with the paradigm of hard sciences is “real” [56], thus relegating subjectivity to the realm of the unverifiable. This raises the problem of what is meant by ‘reality’ and whether the judgment that something is ‘real’ is based on its compatibility with a prevailing paradigm and/or the availability of appropriate investigative tools; for example, microbes existed and caused epidemics well before humans invented the microscope, but were not considered ‘real’ until we had the tools to observe them and assimilate them into a biological paradigm.

## From ASC to NOME

The above discussion lays the basis for a revision of the very concept of ASC. Table 2 illustrates how the term ASC has been used to include a number of experiences and mental phenomena of differing nature and meaning. The adjective “altered” often implies a general attitude toward all these conditions as not only different from, but deficient compared to, ordinary waking consciousness, which is considered the only “non-altered” state. But whereas sleep, a physiological activity in which we spend a third of our lives, is considered an altered state, it is not only a normal part of our diurnal cycle but a *sine qua non* for good health. ASCs commonly associated with religion, spirituality, or parapsychology have been disparaged as culturally deviant or interpreted as psychopathologic because of their similarities to hallucinations.

On the other hand, the concept of “normal consciousness” is not well defined, referring mostly to what appears to be the prevailing condition of ordinary people. The literatures of medicine and psychiatry do not provide a clear and simple definition of normality, often misunderstanding the different states of the mind and classifying as a disorder what is not [57]. The concept of disorder itself appears at least partly arbitrary with important theoretical, biological, and sociocultural implications, and the concept becomes even more elusive when we talk about *psychological disorders* [58]. However, the definition of physical disorders may also be more arbitrary and based on convention than commonly believed.

For example, atypical trigeminal neuralgia, Charlin’s supraorbital neuralgia, and Sluder’s nasopalatine neuralgia, disorders in the international classification of pain syndromes of the head for more than 30 years, were removed in 2004 because they were now deemed to be non-existent [59]; the pathophysiology of a questionable complex of disorders classified as “medically unexplained physical symptoms”, including fibromyalgia, chronic fatigue syndrome, Gulf War syndrome, and idiopathic environmental intolerance, remains uncertain and their very reality questioned [60]; and premonitory dreams or visions, which were considered normal (if not desired) in the ancient world, are usually classified as hallucinatory in our society, with at least the implication of pathology. Therefore the criteria for what constitutes an “altered state” or a “disorder” are partly elusive and essentially determined by convention.

Until a few decades ago, hallucinations were often considered a sign of cerebral dysfunction related to psychosis, but the scientific community has now acknowledged that hallucinatory experiences are more common than previously thought [61,62]. Following clinical reports of individuals who seemed well-adjusted and happy hearing voices that no one else did, a series of large-scale epidemiological studies in different countries has documented a prevalence of hallucinations of up to 15% among people who do not feel the need for psychiatric help [63]. There is a continuum of experiences defined as hallucinatory, ranging from normality to symptoms of schizophrenia, justifying the study of the physiology of those events that lie beyond the boundaries of inner dialog. Maybe what Jaynes called the “bicameral mind” [64] is not extinct but only atrophied, surviving today as an unfairly discredited faculty, suppressed by a culture devoted to physical reality and suspicious of the inner world and non-ordinary events. Here, too, attempts to define a clear border between normality and pathology involve arbitrary criteria that may enhance the standardization of diagnostic criteria at the expense of excluding normal phenomena that share only some characteristics with those considered pathological [65].

These data suggest the need for a broader approach to avoid classifying a priori as “disorders” phenomena that are currently without explanation. With regard to ASCs, the existence of some rare phenomena of parapsychological or religious tonality, such

as stigmata and xenoglossy, is certain; what is uncertain is the scientific interpretation of their pathophysiology and their meaning. As far as other NOMEs are concerned, such as NDEs, mystical experiences, meditation, hypnosis, and those resulting from the use of psychoactive substances, all of them have been studied separately, using different instruments and contexts. In the absence of interdisciplinary contacts, it is difficult to obtain an overview highlighting similarities and differences, in order to get a broader comprehension.

The definition of NDEs developed from the study of life-threatening conditions and most of the research on NDEs has been conducted by health care professionals. However, rare experiences described as “NDE-like” have been reported, similar to classical NDEs but in the absence of any physical or psychological disorder. These experiences are relevant for their potential implications for reductionist approaches to NDEs [66]. Additionally, 30 years of research has uncovered no evidence suggesting that NDEs are associated with dysfunction [11].

The transcendent tones of NDEs and NDE-like experiences, though they differ in some respects, are similar to mystical experiences [67]; there is a vast literature about the latter phenomena, although it is primarily confined to the domains of psychology, philosophy, and religion [68]. On the other hand, there is a link between NDE and hypnosis [69] as well as between hypnosis and meditation [47,70,71]. After all, meditation, which has been the essential introspective method for enlightenment in the East for over 2500 years and the experience of the divine in Western mystical currents, enables one to evoke visions and vivid mystical experiences. Recent neuropsychological studies on meditation have strongly suggested that it is capable of enabling one to control unconscious activities and yield both functional and plastic brain changes [72–79].

Hypnosis, misinterpreted for two centuries in terms of suggestibility and loss of control and choice, as a matter of fact is an opportunity to enhance control over stress, pain, memories, and shifts among mental states and emotion [47,80,81]. There is now increasing evidence that it may improve control over unconscious functions, paralleled by activation and/or deactivation of several brain areas: for example, hypnotic analgesia is the result of a top-down regulation of the pain neuromatrix, a widely distributed neural network, including somatosensory, limbic and thalamo-cortical components and subserving the sensory-discriminative, affective-motivational and evaluative-cognitive dimensions of pain experience [82,83]; it is not mediated by endogenous opioids and may be so powerful as to allow for surgery [84–89].

If so, we should move from the classic epiphenomenalist–reductionist stance, considering mind as a passive epiphenomenon of brain circuitry, to the possibility that mind, through training, may in turn change brain activity [90]. This legitimates the hypothesis that the mind–brain relationship is bidirectional, bottom-up and top-down at the same time.

Finally, some have suggested a link between mystical experiences and the physiology and pathology of temporal lobe epilepsy, as in speculation about the possibility that St. Paul and St. Teresa of Avila may have had seizures [3,91], although there is also considerable evidence contradicting that purported association [37,67]. Spiritual experiences are also related to the activation of the fronto-temporo-parietal brain region; parietal systems seem to be involved during trance states also [92], while religious thinking is often associated with the same brain regions involved in processing emotion and self-representation [93] (for a comprehensive analysis of the neuropsychology of religious experience see Fabbro [94]).

In summary, the issues of NOMEs can be outlined as follows:

(a) The neuropsychology of NOMEs is still unclear: we can theoretically assume that there may be a neurocognitive

background common to some of them, like hypnosis and meditation [46,69,70], and some phenomenological overlap such as between NDEs and hypnosis [68], as well as a relationship between ordinary and non-ordinary experiences including those associated with brain disorders.

- (b) Hallucinogens and psychoactive substances can generate ASCs by triggering those neural circuits associated with these phenomena. The claim that these experiences are merely a result of psychoactive substances appears to be a simplistic and unfair application of the axioms of reductionism, as suggested by Jansen [41]: actually each substance may precipitate a wide range of experiences, partially affected by personality factors and strongly depending on rituals and other cultural factors.
- (c) There is a link between NDEs, mystical experiences, psychedelic experiences, and other non-ordinary experiences. A link can be also found with hypnosis, meditation, and existential crises, such as role transitions; the latter can in turn lead to mystical experiences that closely resemble near-death experiences [66,95].

### Towards a new approach

It is time to reassess the nature of NDE within the broader range of spiritual experiences and reconsider the foundations of this complex topic from an open perspective able to encompass all NOMEs, together with their still misunderstood physiology. Such a multidisciplinary perspective should help create a common language for neuroscience, psychology, philosophy, anthropology, and other disciplines. It should also facilitate a flexible approach that is both top-down and bottom-up at the same time, without privileging either method. It might allow a new promising approach to the longstanding debate about the body–mind relationship, whose dynamic may resemble the yin-yang relationship of Taoism rather than a simple, one-way static mechanism; it is now clear that brain activity allows the manifestation of mental phenomena, but at the same time mind shapes our brain, yielding both functional and plastic changes [96].

We therefore believe that we are evolving and to some extent self-directing beings, able to intentionally influence the development of some of our functions and capabilities, a possibility not acknowledged in the prevailing deterministic and materialistic stance of biology and medicine, which focuses primarily on the computational and neuroanatomical aspects, a stance that has led to the philosophical belief that our minds are only the byproduct of our brains [97]. This new approach may help the advancement of our understanding of subjective phenomena, especially those that have been prejudicially discredited and/or misunderstood in the past century. This happened to both ordinary and non-ordinary experiences and mental phenomena that appear irrational, which were a priori considered as less valuable or even dysfunctional from the post-enlightenment rationalistic stance. For example, mental imagery was considered as a feature of children and non-civilized people in the first half of 20th century [98] and only recently its cognitive and metacognitive power has been reappraised [99]; likewise, emotions were wrongly considered as more primitive and less valuable than the light of reason, although they are essential for cognition and executive control themselves, as delineated in Damasio’s somatic marker hypothesis [48,100,101].

The above misinterpretations are compatible with the adopted paradigm limited to a rigorous 3PP while excluding 1PP, heir of Wundt’s experimental psychology and behaviorism. The belief that this 3PP is limited to the observation of behavior from the outside is inaccurate, however, because the theoretically objective description of the observed behavior is inevitably filtered through the

unconscious prejudices, beliefs, and cultural filters of the observer. On the other hand, a careful recording of subjects' narration of their experience does not contradict the 3PP; indeed, it is itself a third person objective assessment of the first person perspective, which is critically relevant to our understanding of subjective phenomena.

In agreement with Chalmers [102], we believe that NOMEs can be properly evaluated and understood only by integrating the 1PP and the 3PP, that is, sharing the content and meaning of experiences and relating them to their neurocorrelates. The use of only the traditional 3PP implies a high risk of misunderstanding, since any non-ordinary experience is unintentionally and prejudicially perceived as strange, less valuable, or dysfunctional, on the basis of the observer's unacknowledged 1PP; for example, hypnosis was considered as a sleep-like condition for some two centuries, as a result of the 3PP's lack of appreciation for the mental phenomena.

This approach may also lead to a reappraisal of the very definition of ASC, which is unsatisfactory due to two main flaws. First, the term ASC refers to something else and perhaps abnormal in comparison to the "normal" state of consciousness: however, the latter is not much better defined than the former and seems to be related to a naive conception of one's mental state. Second, ASC includes a misleadingly checkered mix of both physiological and pathological conditions, leading to the need to introduce the terms Anomalous Experiences (AEs; 63) and NOMEs, in order to differentiate non-pathological from pathological ones. There is certainly an overlapping or superimposition of the terms AE and NOME. However, while the term AE is focused on experiences, NOMEs lay stress on the conscious and unconscious processes involved and the possibility of their intentional control. Although many phenomena may be considered both AEs and NOMEs, some NOMEs, like hypnosis and meditation, are much more than experience (unlike hallucinations and alien abduction experiences): the training in meditation may lead to deep transformation and capability of intentionally controlling them with the related meta-cognitive implications, a field investigated for over 2000 years by Eastern philosophies and mystic currents.

We do not claim that we have invented a new paradigm. We only propose the adoption of an emerging paradigm championed by others that may help us go beyond the limits of the mechanistic–reductionistic stance (but without rejecting that viewpoint entirely), particularly in the study of subjective phenomena. Our aim is to provide a historical-epistemological perspective on the limits of the dominant 3PP in the neurosciences, and to promote a paradigm that employs both 3PP and 1PP, an approach introduced by Francisco Varela, father and pioneer of neurophenomenology [103], which has begun to be used by a small group of scientists only in recent years (e.g., [44,104,105]).

In conclusion, we might compare the analysis of the body–mind relationship to listening to a recording of a chamber music concert: in the absence of additional information, it may be impossible to discern whether there is a conductor beyond the musicians. If we consider the creativity and unpredictability of the human mind, then a more appropriate metaphor might be a jazz concert, in which the musicians are improvising rather than following a score with definable hierarchies. The next note or bar of the music becomes unpredictable to both listeners and musicians and the melody may be thought of as collapsing from among infinite scenarios into reality only when it is heard.

#### Conflicts of interest statement

The authors disclose that there are no financial and personal relationships with other people or organisations that could inappropriately influence their work.

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