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Research Article

Within-subject comparison of near-death and psychedelic experiences: acute and enduring effects

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Abstract

Mystical-like states of consciousness may arise through means such as psychedelic substances, but may also occur unexpectedly during near-death experiences (NDEs). So far, research studies comparing experiences induced by serotonergic psychedelics and NDEs, along with their enduring effects, have employed between-subject designs, limiting direct comparisons. We present results from an online survey exploring the phenomenology, attribution of reality, psychological insights, and enduring effects of NDEs and psychedelic experiences (PEs) in individuals who have experienced both at some point during their lifetime. We used frequentist and Bayesian analyses to determine significant differences and overlaps (evidence for null hypotheses) between the two. Thirty-one adults reported having experienced both an NDE (i.e. NDE-C scale total score ≥27/80) and a PE (intake of lysergic acid diethylamide, psilocybin/mushrooms, ayahuasca, *N*,*N*-dimethyltryptamine, or mescaline). Results revealed areas of overlap between both experiences for phenomenology, attribution of reality, psychological insights, and enduring effects. A finer-grained analysis of the phenomenology revealed a significant overlap in mystical-like effects, while low-level phenomena (sensory effects) were significantly different, with NDEs displaying higher scores of disembodiment and PEs higher scores of visual imagery. This suggests psychedelics as a useful model for studying mystical-like effects induced by NDEs, while highlighting distinctions in sensory experiences.

Keywords: near-death experience; psychedelic; phenomenology; impact; memory

Introduction

There are a variety of means to attain mystical-like and other nonordinary states of consciousness. Arguably, one of the most robust and reliable methods is via the use of psychedelic compounds (Griffiths et al. 2006). The so-called 'mystical' or 'mystical-like' states of consciousness produced by high doses of psychedelics can also arise unexpectedly in specific practices and contexts such as during meditation or life-threatening events (Martial et al. 2020a, Brouwer and Carhart-Harris 2021). Research suggests that 4%–8% of the general population has experienced a near-death experience (NDE) (Schmied et al. 1999, Knoblauch et al. 2001, Perera et al. 2005). A classical NDE can be defined as a state of disconnected consciousness (i.e. having a subjective experience in a state without connection to the external sensory environment) with prototypical mystical features typically occurring in individuals in life-threatening contexts (Martial et al. 2020b). Prototypical features of NDEs are out-of-body experiences, meeting entities or beings, and seeing a bright light (Charland-Verville et al. 2014, Martial et al. 2017, 2020a).

It has been recently shown that both NDEs and psychedelic experiences (PEs) share common characteristics, such as similar phenomenological features (Timmermann et al. 2018, Martial et al. 2019), and enduring changes regarding attitudes, behaviours, and beliefs (Sweeney et al. 2022). In terms of phenomenology, NDEs seem to particularly resemble subjective experiences induced by classic psychedelics (i.e. serotonin-2A receptor agonists), such as *N*,*N*-dimethyltryptamine (DMT) (Timmermann et al. 2018), psilocybin and 5-MeO-DMT (the 5-methoxylated analogue of DMT) (Martial et al. 2019, Michael et al. 2023), as well as atypical psychedelics, such as the NMDA-antagonist ketamine and the κ receptor agonist salvinorin A (Corazza and Schifano 2010, Martial et al. 2019). Common features may include entering an unearthly environment, a profound sense of unity, extrasensory perceptions, and the experience of ego dissolution (Timmermann et al. 2018, Martial et al. 2021, Michael et al. 2023). However, while NDEs and PEs can exhibit many similarities, they seem to not be identical, with some features, such as the experience of a border/point of no return, that are

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more frequently reported in NDEs (Timmermann et al. 2018, Michael et al. 2023).

Simulating the core features of NDEs via the use of pharmacological means provides a way to model assumptions regarding the neurophysiological mechanisms underlying these experiences (Fritz et al. 2024). For example, given the similarities between classic/atypical psychedelics and NDEs, it could be hypothesized that both serotonergic and glutamatergic mechanisms could underlie core NDE features (Timmermann et al. 2018, Martial et al. 2019)—see also Dean et al. (2019).

NDEs and PEs also appear to be similarly life-changing and can profoundly affect people's sense of self, perspectives regarding death, feelings of relatedness with nature, and worldviews (Groth-Marnat and Summers 1998, Knoblauch et al. 2001, Noyes et al. 2009, Timmermann et al. 2021, Sweeney et al. 2022). Such impacts, in addition to other factors such as cultural background (Kellehear 1993), can also shape the interpretation of the experience, attribution of meaning, or appraisals of the contents experienced (Carhart-Harris et al. 2018). Therefore, it seems that both types of experiences share common characteristics in terms of not only phenomenology but also their enduring impact. However, so far, current research investigating the overlap between NDEs and PEs is limited since it consists of studies only performing between-subject comparisons (e.g. Timmermann et al. 2018, Martial et al. 2019). Between-subject comparisons only provide indirect means to address the potential overlaps between NDEs and PEs and suffer from spurious confounding factors across populations (e.g. personality traits and cognitive abilities) and an inability for the same individual to serve as their own control—which would enable a direct and less confounded comparison regarding the experience.

In the present study, we performed a comparison of NDEs and experiences induced by classic psychedelics [lysergic acid diethylamide (LSD), psilocybin/mushrooms, ayahuasca, DMT, or mescaline] in people who have experienced both. The present study used an online survey in a within-subject design to better understand the phenomenological features shared by both NDEs and PEs, as well as overlaps pertaining their appraisals, attribution of reality, ensuing psychological insights, and enduring effects. We used not only frequentist analyses to assess differences between NDEs and PEs but also Bayesian analyses to assess overlaps between these experiences. Based on the existing between-subject studies, we expect relatively large overlaps in terms of phenomenology and enduring effects between both types of experiences.

Methods and materials

Participants and procedure

Participants were recruited via social media, appearances in local news, and publications of the Coma Science Group (GIGA-Consciousness, University of Liège, BE) and of the Centre for Psychedelic Research (Imperial College London, UK). They were invited to fill in an online survey administered using Alchemer survey design and hosting platform (www.alchemer.com/). Written consent was obtained from all participants on the first page of the survey including the description of the purpose of the study. No compensation was provided. Inclusion criteria were ≥18 years old; being able to read, write, and speak English fluently; and having experienced (at least) one NDE and (at least) one psychedelic drug experience.

The survey included questions related to sociodemographic (i.e. gender, age at interview, nationality, and highest educational level attained) characteristics and a question asking for the total number of PEs experienced so far. Then, respondents were asked to complete a series of open-ended and multiple-choice questions related to a NDE and a PE (defined as the experience following the intake of LSD, psilocybin/mushrooms, ayahuasca, DMT, or mescaline). The order of responses related to both experiences was randomized across subjects. For each of the two types of experiences, we asked individuals to choose their most intense experience if they had had more than one of each type of experience. We chose the agnostic criterion of respondents focusing on experiences based on their general intensity in order to reduce potential biases potentially arising from respondents choosing experiences based on the specific phenomenological similarities between the two experiences of interest. No definitions for NDE or PE were provided for respondents. For each of the two experiences, we first asked the participants to recount their experience in an open-ended fashion in a text box in the survey (the relevant findings concerning these freely expressed narratives will be reported elsewhere). Then, for both experiences, we asked for the (approximate) date of the experience. For the NDE, we also inquired the precipitating factors, whether they had gone through a period of coma >1 h and/or whether they had stayed in the intensive care to gauge the presence of a life-threatening event. Then, we asked them to complete several standardized questionnaires to characterize the phenomenology of both experiences, which included the NDE content (NDE-C) scale (Martial et al. 2020a), the ego dissolution inventory (EDI) (Nour et al. 2016), the ego inflation inventory (EII) (Nour et al. 2016), the 11-dimension altered states of consciousness rating (11-ASC) scale (Studerus et al. 2010), the memory characteristics questionnaire (MCQ) (Johnson et al. 1988, D'Argembeau and Van der Linden 2008), and the psychological insight scale (PIS) (Peill et al. 2022).

We also asked four additional questions regarding the impression of reality and supernaturality for each experience: 'According to you, was this experience supernatural: the experience is attributed to something beyond scientific understanding or the laws of nature?' (yes/no response), 'At the time of the experience, did you consider that this experience was "real" (i.e. different from a dream or a hallucination)?' (a 7-point Likert scale from −3 = '100% imagery/a complete hallucination', 0 = 'as real as daily life/usual reality', to +3 = 'more real than daily life'), 'Do you now consider that this experience is "real" (i.e. different from a dream or a hallucination)?' (a 7-point Likert scale from 3 = '100% imagery/a complete hallucination', 0 = 'as real as daily life/usual reality', to +3 = 'more real than daily life'), and 'Do you think that when you die you will experience something similar?' (yes/no response).

We then administered several questions regarding the impact of each experience (see the Results section for details). The survey ended with the seven additional items directly comparing both experiences. Of these, four items were dedicated to assess the potential similarity (or not) between them: 'To what extent would you say that the NDE and the psychedelic experience were similar?'; 'To what extent were you in a similar state of consciousness when comparing the NDE and the psychedelic experience (in terms of being awake, unresponsive, unconscious, etc.)?'; 'To what extent were the NDE and psychedelic experience similar in terms of sensory perception (visual, auditory, bodily sensations)?'; and 'To what extent were the NDE and psychedelic experience similar in terms of emotions experienced?'. Responses to each of these four items were given on a Likert-type scale ranging from 1 'not at all similar' to 5 'fully similar'. The last three items were 'Which of these two experiences was the most intense?'; 'Which of these two experiences had a larger impact on your life?'; and 'Which of these

two experiences had more/deeper metaphysical consequences on your life (e.g. beliefs about the nature of the mind, reality, the universe)?'. For these last seven items, respondents were invited to endorse the NDE or the PE.

The study was conducted according to the guidelines of the Declaration of Helsinki (1964) and its later amendments and approved by the Ethics Committee of the Faculty of Medicine of the University of Liège.

Materials

The NDE-C scale

The NDE-C is a 20-item self-report scale used to assess the presence of an 'actual' NDE (i.e. scoring above a cutoff score of ≥27/80; Martial et al. 2020a). Additionally, this scale comprises five factors relating to NDE phenomenology: 'beyond the usual, harmony, insight, border, and gateway'. This multiple-choice questionnaire aims to quantify the richness of the experience, with a total score ranging from 0 to 80. For each item, scores are associated with a Likert format scale from 0 (0 = 'not at all; none') to 4 (1 = 'slightly', 2 = 'moderately', 3 = 'strongly; equivalent in degree to any other strong experience', and 4 = 'extremely; more than any other time in my life and stronger than 3').

The EDI

This scale includes eight items assessing experiences of ego dissolution (Nour et al. 2016). Responders are asked to give an estimate on a visual analogue scale (VAS) format from 0 to 100 (with incremental units of one), with 0 = 'No, not more than usual' and 100 = 'Yes, entirely or completely'. The total score is the mean of the eight items. The higher the total score, the stronger the experience of ego dissolution.

The EII

This scale contains eight items to assess experiences of ego inflation (Nour et al. 2016). The items are designed to reflect the distinct experience of unusually elevated self-assuredness and confidence. Responders are asked to give an estimate on a VAS format from 0 to 100, with 0 = 'No, not more than usual' and 100 = 'Yes, entirely or completely'. The total score is the mean of the eight items. The higher the total score, the stronger the experience of ego inflation.

The 11-ASC scale

Participants rated the content of their subjective experiences using the 11-ASC scale (Studerus et al. 2010) containing 42 items in total. The 11-ASC questionnaire has 11 subscales: (i) experience of unity, (ii) spiritual experience, (iii) blissful state, (iv) insightfulness, (v) disembodiment, (vi) impaired cognition and control, (vii) anxiety, (viii) complex imagery, (ix) elementary imagery, (x) audio-visual synaesthesia, and (xi) changed meaning of percepts (Studerus et al. 2010). For each item, respondents were told to indicate their level of agreement on a VAS anchored from 0 ('No, not more than usual') to 100 ('Yes, much more than usual'). The mean score of all the items results in the Global ASC score.

MCQ

The modified version (D'Argembeau and Van der Linden 2008) of the MCQ (Johnson et al. 1988) aims to assess memory characteristics using 16 rating scales assessing features of memory: feelings of re-experiencing; visual details; other sensory details; location; time; coherence; verbal component; emotion while remembering; belief that the event is 'real'; one's own actions, words, and thoughts; visual perspective; emotional valence; personal importance of the memory; and reactivation frequency. A MCQ total score can be derived summing all the 16 items (each on a 7-point Likert scale) and referred to as the total amount of memory characteristics. The higher the total score, the greater amount of memory characteristics.

PIS

The PIS is a scale aiming to measure psychological insight after a PE (Peill et al. 2022). It is a seven-item scale using a 0–100 VAS for each item. A total score can be calculated as the mean of the ratings for items 1–6 (PIS-6 score). Item 7 gives an index of behavioural change in association with potential insights gained in an experience (PIS Item 7).

Statistics

All variables were tested for normality using the Shapiro–Wilk test ($P < .05$). Results were expressed as mean and standard deviation (SD) or as medians with interquartile range (Q1–Q3) for asymmetric distribution. Qualitative variables were described using count and percent. Based on data distribution, paired-samples *t*-tests or Wilcoxon signed-rank tests were used to assess differences in continuous variables. We used McNemar's test for relations between categorical variables. χ^2 tests were used to assess frequency distributions. Results were considered significant at $P < .05$ (two-tailed).

Bayesian analyses were used to complement frequentist analyses and establish if the evidence is sufficient to support the alternative or null hypothesis for each comparison. Bayesian statistics thus become relevant when attempting to establish whether the evidence supports the overlap between NDEs and PEs (i.e. the evidence supporting the null hypothesis). Bayes Factor (BF01) was used to establish the strength of the evidence. The BF01 uses the Cauchy prior centred at 0 (no prior preference concerning the effect) (Rouder et al. 2012). We used the following cutoffs: >10 (strong evidence for H0), 3–10 (substantial evidence for H0), 1–3 (anecdotal evidence for H0; i.e. referring to evidence that is considered as low or weak towards the alternative), 1/3-1 (anecdotal evidence for H1), 1/10–1/3 (substantial evidence for H1), and <1/10 (strong evidence for H1).

Results

Participants

Out of 45 respondents, the final sample consisted of 31 respondents who had fully completed the online survey, and experienced a classical NDE characterized by meeting the NDE-C scale criteria (i.e. total score ≥27/80; Martial et al. 2020a) experienced in a life-threatening situation (i.e. a clearly identified context of an actual threat to life, a context leading to a period of coma >1 h, and/or to a stay in the intensive care) and a PE as the experience following the intake of either LSD, psilocybin/mushrooms, ayahuasca, DMT or mescaline. The sociodemographic information of the 31 participants is given in Table 1.

Context of the experiences

Descriptive information about the context of occurrence of both experiences is presented in Table 2. The age at which the NDE occurred was significantly lower than the one at which the PE happened. The majority of participants (i.e. 24/31) experienced their NDE before the PE.

Table 1. Sociodemographic characteristics of the sample

Characteristics	Description	All participants (*N* = 31)
Gender [No. of participants (%)]	Female	7 (23)
	Male	23 (74)
	Other	1 (3)
Age, years [mean ± SD]		41 ± 13
Highest educational level attained [No. of participants (%)]	Left school before age 16 years without qualifications	2 (7)
	High school diploma	8 (26)
	General educational development	1 (3)
	Associate or technical degree	1 (3)
	College diploma	10 (32)
	Master degree	9 (29)
Nationality [No. of participants (%)]	United Kingdom	9 (30)
	United States	11 (36)
	Bangladesh	1 (3)
	Chile	1 (3)
	Italy	1 (3)
	Ireland	1 (3)
	Costa Rica	1 (3)
	Australia	1 (3)
	Sweden	1 (3)
	Bulgaria	1 (3)
	France	1 (3)
	New Zealand	1 (3)
	Canada	1 (3)
Previous psychedelic drug use [No. of participants (%)]	Only once	0 (0)
	2–5 times	5 (16)
	6–10 times	4 (12)
	11–20 times	3 (10)
	21–50 times	8 (24)
	51–100 times	2 (6)
	More than 100 times	7 (21)

Phenomenology

We found that the NDE included more often the feeling of dying and/or being dead (NDE-C18) as compared to the PE (see Table 3). On the other hand, the PE included more often the experience of unusual sensations [i.e. senses (sight, hearing, smell, touch, and/or taste) experienced in a different manner than usual]. The NDE-C total score was significantly higher for the NDE as compared to the PE. Only four participants had a PE which did not reach the cut-off score of ≥27/80 on the NDE-C scale. A Bayesian analysis was used to complement the comparison of total NDE-C scores between both groups. The resulting BF01 of 0.83 suggests only anecdotal support for a significant difference between NDE and PE groups. Bayesian analysis for each of the items revealed stronger overlaps between NDE and PE groups (substantial support for the null hypothesis) for alterations in time perception, speeding thoughts, hearing a voice, peacefulness, seeing or feeling a bright light, precognition, life review, and feelings of nonexistence.

Table 4 shows the results of all other standardized questionnaires pertaining to the comparison of the phenomenology of NDEs and PEs. We found that the disembodiment subscale of the 11-ASC was significantly higher for NDEs compared to PEs, and BF01 revealed substantial evidence favouring the alternative hypothesis of this difference (BF01 = 0.26). Three other subscales of the 11-ASC were significantly higher for PEs compared to NDEs: 'Complex Imagery', 'Elementary Imagery', and 'Changed Meaning of Percepts', and all these comparisons showed substantial or strong evidence favouring the alternative hypothesis (i.e. supporting a significant difference between NDE and PE). No other significant differences were found. Substantial evidence for NDE and PE overlap (i.e. supporting the null hypothesis of no difference) was found for 'Experience of Unity', 'Spiritual Experience', 'Blissful State', and 'Insightfulness' scales, all of which comprise the 'Oceanic Boundlessness Dimension' in the 5-dimension ASC (Studerus et al. 2010), which has been previously linked to mystical-type experiences (Roseman et al. 2018, Timmermann et al. 2024). Also, substantial evidence for the null hypothesis (i.e. NDEs and PEs showing comparable effects) was found for 'Anxiety' and 'Impaired Control and Cognition' subscales (Fig. 1). The comparison of the Global ASC score revealed no significant differences between NDE and PE; however, a BF01 of 2.06 only supports anecdotal evidence for this null finding.

Appraisals and attribution of reality

Table 5 details the responses for the two items pertaining to the supernatural appraisal of the experience.

Figure 2 shows the responses to the questions regarding the attribution of reality to the experience. The responses to the question 'At the time of the experience, did you consider that this experience was "real" (i.e. different from a dream or a hallucination)?' were not significantly different between NDE and PE. However, we found significantly higher scores for NDE versus PE regarding the current attribution of reality of the experience (*P* = .022) (see Fig. 2). We observed that for the question 'At the time of the experience, did you consider that this experience was "real" (i.e. different from a dream or a hallucination)?', 25 (81%) and 23 respondents (74%) respectively reported that at the time of the experience, they considered the NDE and the PE as more 'real' than daily life (i.e. corresponding to a rating of '+1', '+2', or '+3' on the Likert scale). Two respondents (6%) judged both the NDE and the PE as 'real' as daily life or 'usual reality' (i.e. corresponding to a rating of '0' on the Likert scale). Four (13%) and six respondents (19%), respectively, judged the NDE and the PE as hallucination/imaginary (i.e. corresponding to a rating of '–1', '–2', or '–3' on the Likert scale). For the question 'Do you now consider that this experience is "real" (i.e. different from a dream or a hallucination)?', 23 (74%) and 21 respondents (68%), respectively, reported they consider now that the NDE and the PE were more 'real' than daily life (i.e. corresponding to a rating of '+1', '+2', or '+3' on the Likert scale). Six (19%) and four respondents (13%) judged both the NDE and the PE as 'real' as daily life usual reality (i.e. corresponding to a rating of '0' on the Likert scale). Two (6%) and six respondents (19%) respectively judged the NDE and the PE as hallucination/imaginary (i.e. corresponding to a rating of '–1', '–2', or '–3' on the Likert scale).

Psychological insight and phenomenological memory characteristics

We did not observe significant differences pertaining to the comparison of the psychological insight and phenomenological memory characteristics of NDEs and PEs. Bayesian analyses revealed strong evidence supporting the null hypothesis, suggesting an overlap between NDE and PE regarding psychological insight and memory characteristics (see Table 6).

Table 2. Characteristics of the context of occurrence of both NDE and PE (N = 31)

Characteristics	NDE		PE		P value	Effect size
Age at experience [mean ± SD]	25 ± 8		28 ± 10		**.044**	−0.377
Context [No. of participants (%)]	Anoxia	3 (10)	LSD	14 (46)		
	Trauma	10 (32)	Psilocybin/mushrooms	13 (42)	/	/
	Other (nontraumatic event)	15 (48)	Ayahuasca	2 (6)		
	Unknown causes (occurring spontaneously, cause not identified by the experiencer)	3 (10)	DMT	1 (3)		
			Mescaline	1 (3)		
Period of coma >1 h [No. of participants (%)]	Yes	10 (32)	/	/	/	/
	No	16 (52)				
	The participant does not know	5 (16)				
Intensive care stay [No. of participants (%)]	Yes	12 (51)	/	/	/	/
	No	16 (39)				
	The participant does not know	3 (10)				

Bold characters indicate statistically significant results.

Table 3. Response frequency distributions for each of the 20 NDE-C scale items and total score for both experiences

NDE-C scale items	NDE (N = 31)	PE (N = 31)	P value	Statistic	BF01
Time perception	30 (97%)	29 (94%)	.350	0.554	5.15
Speeded thoughts	21 (68%)	24 (77%)	.393	0.729	3.48
Voice	22 (71%)	18 (58%)	.288	1.13	3.30
Understanding	30 (97%)	26 (84%)	.086	2.95	2.83
Peacefulness/well-being	27 (87%)	27 (87%)	1	0	4.57
Harmony/unity	30 (97%)	28 (90%)	.301	1.07	3.22
Bright light	21 (68%)	21 (68%)	1	0	4.30
Unusual sensation	24 (77%)	30 (97%)	**.023**	5.17	1.55
Extrasensory perception	29 (94%)	30 (97%)	.554	0.350	0.27
Precognition	23 (74%)	20 (65%)	.409	0.683	4.53
Out-of-body experience	28 (90%)	27 (87%)	.688	0.161	1.08
Leaving the earthly world	31 (100%)	29 (94%)	.480	0.50	2.48
Life review	13 (42%)	15 (48%)	.610	0.261	5.13
Encounter	18 (58%)	15 (48%)	.445	0.583	0.85
Nonexistence/void/fear	17 (55%)	17 (55%)	1	0	4.81
Border/point of no return	24 (77%)	18 (58%)	.103	2.66	0.03
Come back	26 (84%)	21 (68%)	.138	2.20	0.04
Dying	26 (84%)	17 (55%)	**.013**	6.15	0.01
Gateway	15 (48%)	18 (58%)	.445	0.583	3.70
Ineffability	29 (94%)	28 (90%)	.641	0.218	1.31
Total score [mean ± SD]	49 ± 12	43 ± 16	**.04**	2.06	0.83

The presence of the item corresponds to a rating of 1, 2, 3, or 4 of the response scoring. Bold characters indicate statistically significant results.

Table 4. Total scores of questionnaires for both experiences

	Questionnaires (min–max total score)	NDE (N = 31)	PE (N = 31)	P value	Effect size	BF01
	EDI (0–100) [median (Interquartile range [IQR])]	74 (52–98)	66 (46–91)	.098	0.307	1.43
	EII (0–100) [median (IQR)]	32 (0–52)	24 (1–39)	.124	0.319	1.68
11-ASC	Experience of Unity (0–100) [median (IQR)]	63 (48–85)	65 (51–86)	.821	−0.043	5.10
	Spiritual Experience (0–100) [median (IQR)]	50 (35–72)	63 (40–85)	.672	−0.082	4.79
	Blissful State (0–100) [median (IQR)]	67 (46–88)	67 (20–85)	.282	0.211	3.01
	Insightfulness (0–100) [median (IQR)]	50 (27–74)	58 (37–78)	.269	−0.217	2.92
	Disembodiment (0–100) [median (IQR)]	74 (59–100)	43 (19–84)	**.012**	0.518	0.26
	Impaired Control and Cognition (0–100) [median (IQR)]	29 (14–54)	26 (10–52)	.881	0.029	5.17
	Anxiety (0–100) [median (IQR)]	14 (1–45)	23 (6–51)	.588	−0.105	4.54
	Complex Imagery (0–100) [median (IQR)]	33 (15–44)	60 (32–68)	**.018**	−0.484	0.37
	Elementary Imagery (0–100) [median (IQR)]	35 (1–81)	81 (52–95)	**.003**	−0.633	0.08
	Audio-visual Synesthesia (0–100) [median (IQR)]	28 (1–77)	56 (16–92)	.088	−0.441	1.30
	Changed Meaning of percepts (0–100) [median (IQR)]	33 (20–61)	62 (27–78)	**.005**	−0.589	0.12
	Global ASC score (0–100) [median (IQR)]	38 (31–56)	52 (38–62)	.162	−0.276	2.06

Bold characters indicate statistically significant results.

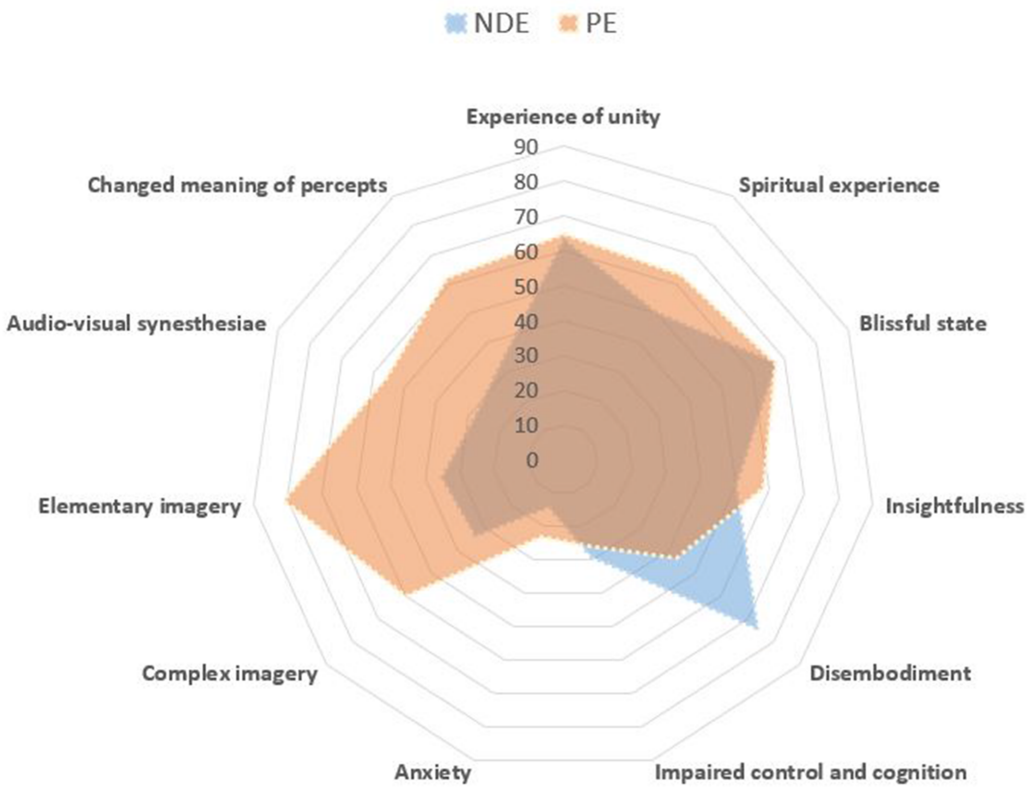

Figure 1 NDEs and PEs are plotted on the radar chart according to their score on the 11 subscales of the 11-ASC

Table 5. Interpretation of the experiences

Characteristics		NDE (*N* = 31)	PE (*N* = 31)	*P* value
'Supernatural' experience [No. of participants (%)]	Yes	17 (55)	16 (52)	.585
	No	4 (13)	7 (23)	
	The participant does not know	10 (32)	8 (26)	
Do you think that when you die you will experience something similar [No. of participants (%)]	Yes	16 (52)	13 (42)	.075
	No	1 (3)	7 (23)	
	The participant does not know	14 (45)	11 (35)	

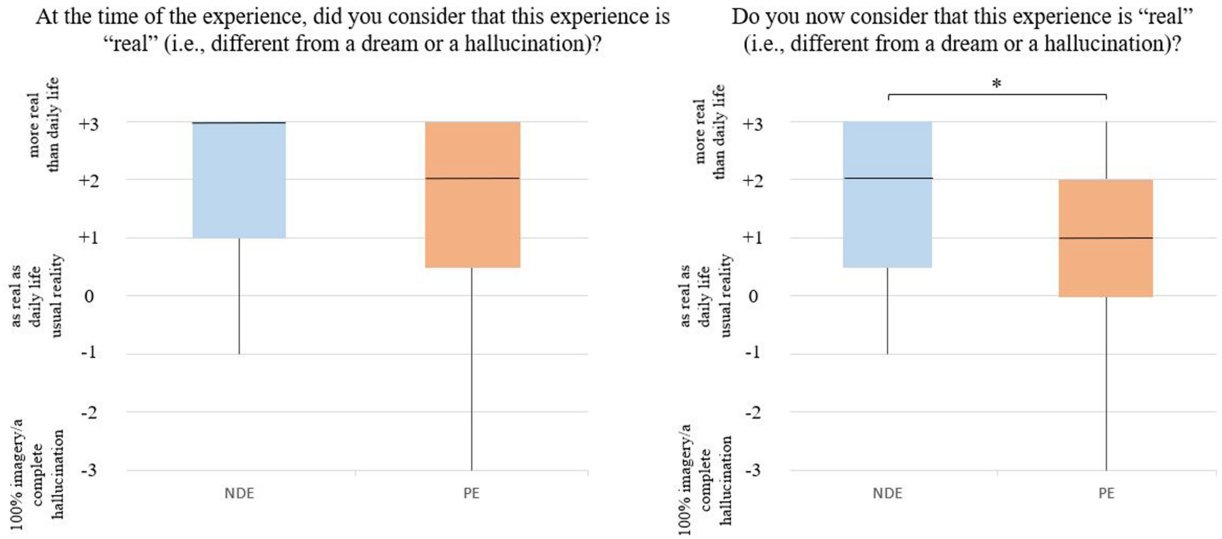

Figure 2 Participants' responses on the 7-point Likert questions regarding the attribution of reality for the NDE and for the PE; *$P < .05$

Table 6. Total scores of questionnaires for both experiences

Questionnaires (min–max total score)	NDE ($N = 31$)	PE ($N = 31$)	*P* value	Effect size	BF01
MCQ (0–112) (mean ± SD)	78 ± 14	78 ± 13	.951	–0.011	5.21
PIS-6 (0–100) [median (IQR)]	56 (25–98)	55 (34–82)	.861	0.031	5.15
PIS item 7 (0–100) [median (IQR)]	63 (33–96)	60 (42–90)	.525	0.115	

Impact

Table 7 details the responses to the questions related to the impact of both experiences. Bayesian analyses revealed substantial evidence for the null hypothesis (i.e. significant overlap between NDE and PE) for items pertaining to the impact of these experiences on lifestyle, worldviews, and beliefs/opinions concerning the existence of a cosmic connection (i.e. belief in the interconnectedness of all/some things in a spiritual sense). Furthermore, overlaps were found for reductions in concerns or worries, increases in the ability to step outside of oneself, and experiencing things as doubly 'real' after these experiences took place. Finally, overlaps were found with regard to how personally and spiritually meaningful were these experiences. Results revealed that the impact of the NDE was significantly regarded as more negative compared with the PE; however, Bayesian analyses revealed only anecdotal evidence for the alternative hypothesis. Significantly larger responses were found for the impact of the PE on respondents' relationship to others compared with the NDE (supported by substantial evidence in Bayesian analysis) and the NDE resulting in individuals reporting being less afraid of death compared with the PE (supported by strong evidence for this difference in Bayesian analysis).

Direct comparison between NDE and PE

Figure 3 includes the graphs of the four questions assessing the potential similarity between both experiences.

Figure 4 includes the graphs of the three questions asking the participants to endorse the NDE or the PE depending on the question. We did not find significant differences between both experiences for the three questions ('intense' question: $P = .857$; 'impact on your life' question: $P = 0.106$; 'more/deeper metaphysical consequences' question: $P = .590$).

Discussion

The present study provides the first group quantitative study exploring within-subject comparison between NDE and PE. Thirty-one people who reported having experienced both a NDE (i.e. meeting the criteria for NDEs: NDE-C scale total score ≥27/80; Martial et al. 2020a) and a PE (intake of LSD, psilocybin/mushrooms, ayahuasca, DMT, or mescaline) responded to our online survey assessing the phenomenology and potential impact of both experiences.

Regarding the characterization of phenomenology typically attributed to NDEs, we observed a substantial overlap in altered sense of time, peacefulness, seeing or having the feeling of being surrounded by a bright light, precognition, life review, and experiencing a feeling of nonexistence or a void. We only observed two significant differences regarding the feeling of dying and/or being dead (stronger for NDEs compared with PEs) and the experience of unusual sensations (stronger for psychedelic compared with NDEs). These findings are consistent with what was found in the between-subject comparison of NDE and PE from the study by Martial et al. (2020a). The NDE-C total score was significantly higher for the NDE as compared with the PE; however, Bayesian analyses revealed that the evidence supporting this difference is only anecdotal and further data are needed to determine this difference. Furthermore, only four participants had a PE which did not reach the cut-off score for an NDE(-like) on the NDE-C scale. Indeed, the total score median observed here for PEs is particularly high (i.e. 43 ± 16), higher than what was found in the validation paper of the NDE-C scale (Martial et al. 2020a) (i.e. 30 ± 16). It is worth noting that the latter study did not restrict the inclusion to classic psychedelics but also included the entactogen 3,4-methylenedioxymethamphetamine which is known to induce effects relatively dissimilar to both NDEs (Martial et al. 2019) and classic psychedelics (Roseman et al. 2014). Another possibility could be that our respondents have been influenced by their NDE, as most of our participants experienced their NDE before their PE.

Consistent with the finding that unusual sensations were stronger for PEs compared with NDEs, analysis of the 11-ASC scale revealed stronger scores of visual imagery scales ('Elementary Imagery' and 'Complex Imagery') for psychedelics compared with NDEs. We also found 'Disembodiment' to be stronger for NDEs compared with classic psychedelics, revealing how sensory modalities are differentially altered in both experiences (i.e. PEs engage the visual system more, while NDEs disrupt bodily feelings more strongly; Blanke et al. 2016). We note that ketamine also shows a similar profile on the 11D-ASC (Farnes et al. 2020). We also found higher scores in PEs for 'Changed Meaning of Percepts', which was expected considering how PEs induce stronger visual effects and this scale restricts enhanced attribution of meaning to visual information. Further research is needed to determine whether NDEs also enhance the attribution of meaning to other sensory modalities or thoughts and ideas, in a similar way as psychedelics seem to (Studerus et al. 2010). Intriguingly, Bayesian analyses revealed that while sensory modalities appear to differ between these experiences, a significant overlap can be found with regard to mystical-type effects (as determined with the subscales 'Spiritual Experience', 'Experience of Unity', 'Insightfulness', and 'Blissful State'). Thus, our results reveal an overlap in mystical-like effects, while low-level phenomena (i.e. sensory effects) diverged between both experiences, as demonstrated by the respondents' responses to the 11D-ASC.

While we did not find significant differences between ego dissolution and inflation between the two experiences, Bayesian analyses implied that evidence supporting an overlap is merely 'anecdotal'—meaning that it is not strong. Further research is needed to explore whether 'self'-related processing is equally disrupted in both experiences. Overall, these results are partially consistent with findings from the NDE-C scale and reveal some overlap between psychedelic and NDEs when it comes to mystical-type effects but not for sensory effects, which appear to differ between both states. Although the overlap between the phenomenology of the classic PEs and NDEs was highlighted in Raymond Moody's bestseller (1975), our study is the first group quantitative study exploring within-subject comparison between both types of experience.

When asked about their attributions at the time of the experience, a high percentage of respondents attributed their NDE

Table 7. Impact questions

Characteristics	NDE (median)	PE (median)	P value	Effect size	BF01
Did the experience have a significant impact on your lifestyle? 0 = no impact/5 = very significant impact	3	4	.734	−0.083	5.14
Did the experience have a positive effect on your well-being? 0 = no effect/5 = very significant effect	4	4	.406	−0.214	3.33
Did the experience have a negative effect on your well-being? 0 = no effect/5 = very significant effect	0	0	.199	0.390	1.53
Did the experience have a significant impact on your worldviews? 0 = no impact/5 = very significant impact	4	4	.612	−0.140	4.57
Did the experience have a negative impact on your life? 0 = no impact/5 = very significant impact	1	0	**.043**	0.591	0.69
Did the experience have a significant effect on your feelings of self-acceptance? Decreased self-acceptance = 1/no effect = 4/increased self-acceptance = 7	5	6	.112	−0.360	1.50
Did the experience have a significant effect on your relationship with others? I'm more oriented towards myself = 1/no effect = 4/I'm more friendly/open towards others = 7	5	6	**.015**	−0.676	0.30
Have your beliefs/opinions changed regarding death? I'm much more afraid of death = 1/no effect = 4/I'm not afraid of death anymore = 7	6	5	**.003**	0.740	0.06
How personally meaningful was the experience? No more than routine/everyday experiences = 1/the single most meaningful experience of my life = 7	5	4	.379	0.257	3.30
Have your beliefs/opinions changed regarding afterlife? I'm less convinced of the existence of an afterlife = 1/no effect = 4/I'm more convinced of the existence of an afterlife = 7	6	5	.129	0.385	1.77
Have your beliefs/opinions changed regarding religion? Less religious beliefs = 1/no effect = 4/more religious beliefs = 7	4	4	.321	−0.333	2.90
Have your beliefs/opinions changed regarding the existence of a cosmic connection? I'm less convinced of the existence of a cosmic connection = 1/no effect = 4/I'm more convinced of the existence of a cosmic connection = 7	7	7	.544	0.197	3.96
Have your beliefs/opinions changed regarding love? Decreased sense of importance of love = 1/no effect = 4/increased sense of importance of love = 7	6	6	.254	−0.362	2.58
Did you experience a reduction in concerns or worries following the NDE? Reduction in worries = 1/no effect = 4/increasing worries = 7	3	3	.700	0.105	5.06
Did the NDE allow you to expand your mental abilities (i.e. increase awareness and flexibility of your mind, perception and/or enhance your capacity to use some mental abilities such as visualization)? 0 = not at all/5 = fully more expanded mental awareness	4	4	.962	0.019	5.20
How spiritually significant was the NDE for you? 0 = no spiritually significant/5 = the single most spiritually significant experience of my life	5	4	.406	0.214	3.21
Since then, did the experience allow you to improve your ability to step outside your usual self and to experience an entirely different state of being? Yes = 1/no = 0/2 = I don't know	1	1	.832	0.090	5.10
Since then, did the experience allow you to experience things as if they were doubly real? Yes = 1/no = 0/2 = I don't know	1	1	.851	0.088	5.07

Bold characters indicate statistically significant results.

(74% of the respondents) and PE (68%) as being more 'real' than daily life. By contrast, only 19%/13% of respondents considered the NDE/PE as equivalently 'real' as daily life, and a minority (6%/19%) considered, respectively, the NDE/PE as 'real' as a hallucination or imagination. In parallel, regarding their current attribution of reality, the NDE was considered to be more 'real' than the content experienced during the PE, consistent with the finding that NDEs have a strong impact on beliefs and notions regarding death—as we found here and as others have found previously (e.g. Ring 1984, van Lommel et al. 2001, Schwaninger et al. 2002, Thonnard et al. 2013, Tassell-Matamua and Lindsay 2016).

One can hypothesize that NDE is more often associated with an impression of 'suprareal' due to its unexpected and involuntary occurrence, as compared with a PE which is (typically) intended. Indeed, for PEs, the individual knows (s)he is taking a drug and the context is generally not a life-threatening situation. Consequently, the interpretation of (the meaning of) the experience may differ between both because of this context. However, it is worth mentioning that our respondents reported particularly high scores on the Likert associated with this question on the impression of reality for PEs too. It is possible that both psychedelics and NDEs carry with them a strong attribution of reality due to the noetic quality (i.e. a sense of insight with a strong feeling of certainty) of mystical-type effects (which we see here are comparable in both experiences). This noetic quality has been characterised as a feature of experience in which insights feel meaningful and fun-

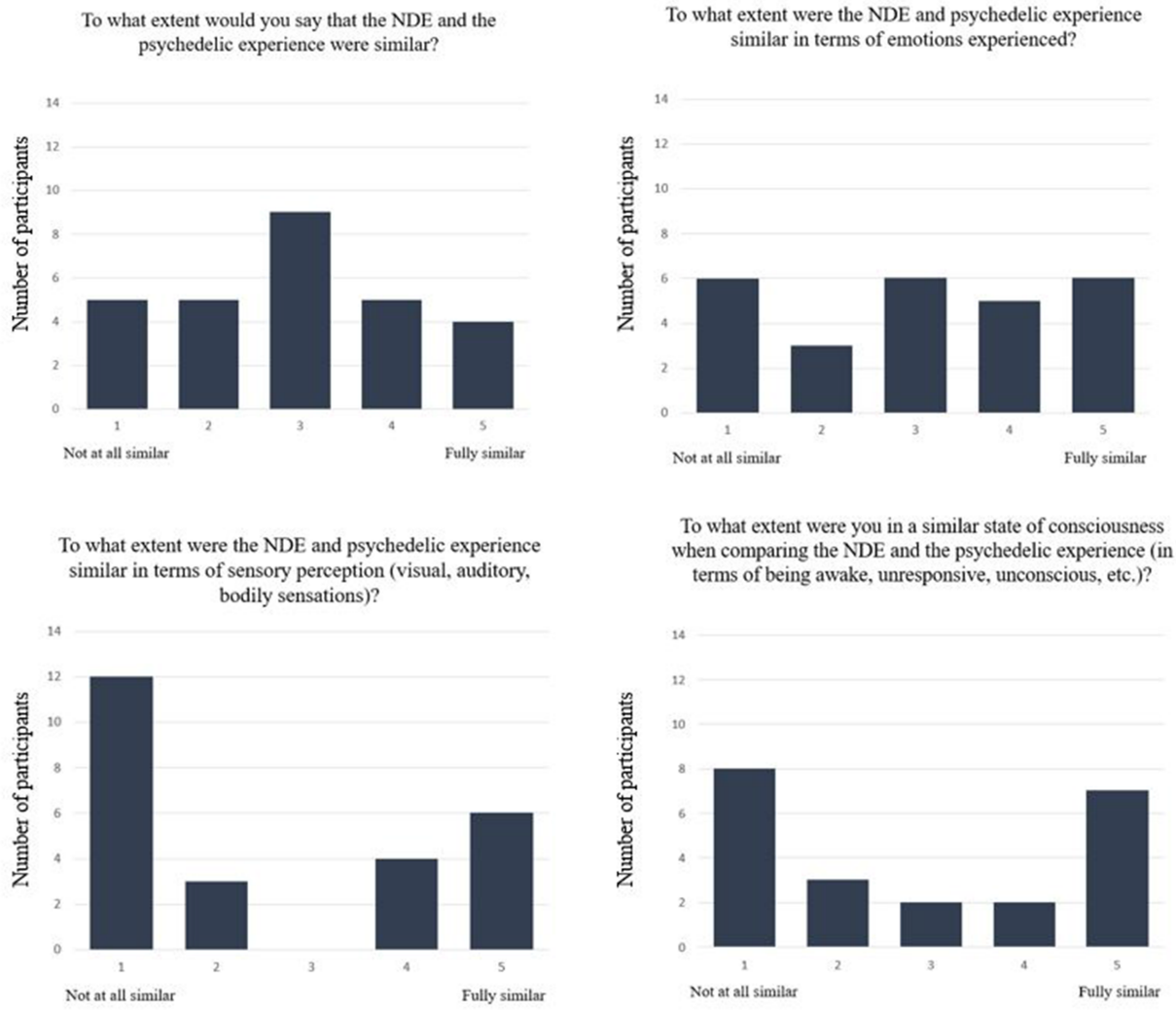

Figure 3 The number of participants according to their responses on a Likert-type scale ranging from 1 'not at all similar' to 5 'fully similar' to four questions assessing the potential similarity between NDE and PE ($N = 31$)

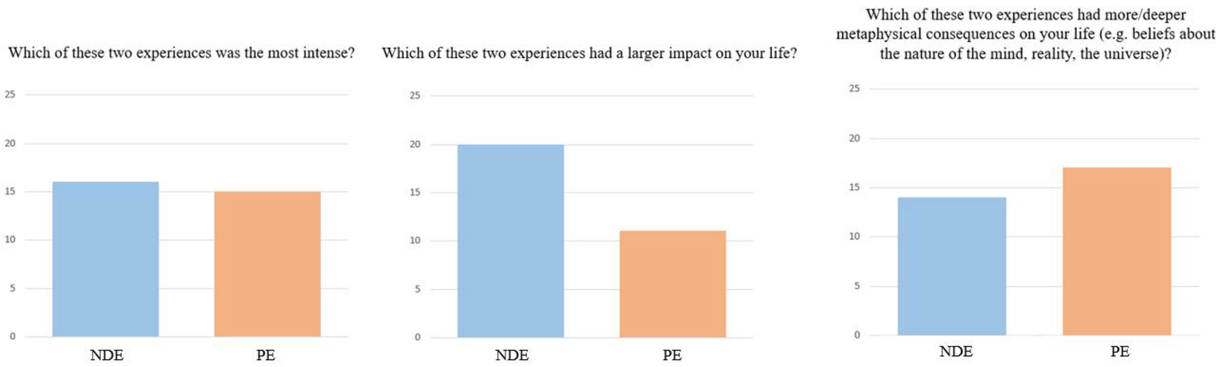

Figure 4 The number of participants according to their choice between the NDE and the PE to three comparison questions

damental, while also having an unmediated quality, which grants them a lasting impact in the individual (James 1902, Timmermann et al. 2022).

Regarding other attributions, we found overlaps for the supernatural attribution to both experiences, as well as for a question asking to what extent they think that when they actually die, they will experience something similar. We also found a meaningful overlap between NDEs and PEs regarding psychological insights and associated behavioural changes. For both experiences, psychological insight and associated behavioural changes adopted after the experiences were scored relatively highly compared to the original validation data (participants who have consumed psychedelics) for this new measure by Peill et al. (2022). Although the phenomenon of psychological insight after a PE is

now beginning to be measured (e.g. Davis et al. 2021, Peill et al. 2022), insights and associated new behaviours acquired after an NDE have not been studied. This is relevant as insights and subsequent behavioural changes have been found to mediate mental health benefits attributed to psychedelics (Davis et al. 2020, Peill et al. 2022), and a similar mechanism may be at play during NDEs.

It seems that there is also a substantial overlap between NDE and PE in terms of long-term psychological changes. Among all questions administered regarding the potential impact of the experiences, only three showed significant differences. Respondents reported being more friendly/open towards others after the PE compared with NDEs. They also reported that the NDE not only had a more negative impact on their life but also is less afraid of death anymore as a consequence of the NDE, as compared with PE. The finding of reduced anxiety regarding death after an NDE is consistent with previous research (Noyes et al. 2009, Tassell-Matamua and Lindsay 2016). While there are so far no empirical studies exploring the processes underlying this reduction in fear of death, one can hypothesize that this may be due to the nature of the NDE itself or the perception of death as a transition to another phase of existence—rather than complete annihilation (Moody 1975, Greyson and Stevenson 1980, van Lommel et al. 2001). By contrast, the negative impact of the NDE may have been due to various other aspects of the experience, such as the context and the difficulty in describing it afterwards.

Finally, the four general questions assessing the potential similarity between both experiences where the participants had to endorse either the NDE or the PE yielded very mixed results. This could be attributed to the fact that these experiences constitute heterogeneous categories of subjective experiences (for instance, due to the variability of ingested substances or the diversity of contexts) and/or that they possess both similarities and differences at various levels—as shown by the results of the various questionnaires—and that the questions were so broad which may have made each respondent to focus on different aspects of the experiences when answering. As such, these direct answers are generic and prone to biases (of judgement and recollection) and reflect the value of the separate assessment of phenomenology between NDE and PE experiences in several dimensions of interest.

It is important to acknowledge the limitations of the present study which warrant caution when extrapolating these findings. First, our study relied on self-report questionnaire formats and some self-constructed items that were not validated. The content and style of our questions may be prone to biases linked to first-person measures—such as (correct) inferences on study demand characteristics biasing outcomes in favour of our prior hypotheses. Since our goal was to study subjective experiences, we necessarily relied on retrospective subjective measures. But this does not prevent that subjective measures may be biased by memory distortions. One can nonetheless observe that the ratings obtained on the MCQ were particularly high, as compared to what can be typically found in the literature for non-NDE event memories (see, for instance, the ratings reported in D'Argembeau and Van der Linden 2008). This suggests that both types of experiences are associated with a substantial number of features (whether sensory, contextual, semantic, and/or emotional) that characterize the phenomenological experience associated with remembering. In addition, the use of questionnaires has the advantage of quantitatively assessing the relevant phenomena using validated tools (in some cases) and the testing-specific hypotheses. However, questionnaires may limit the exploration of the broader phenomenology associated to these experiences and may also be vulnerable to demand characteristics, which previous research has found may be exacerbated in psychedelic-like experiences (such as when reporting about an NDE; Olson et al. 2020). Related to this issue, there is also the issue of specificity, referring to the possibility that respondents tend to endorse a broad array of concepts without being really specific. We are currently performing parallel analyses, exploring qualitative responses from the same individuals to refine the phenomenological overlap between these experiences. Second, volunteers enrolled in this study were self-selected and hence might not be representative of a broader population. Third, the present sample is relatively small. Given the specificity of this population who have experienced both types of experiences, the recruitment of volunteers was arduous. Future studies should include a larger group of volunteers. Another limitation is the retrospective design of our study which does not allow us to determine conclusions about the casual influence of these experiences on their reported impact. Another limitation is the self-constructed nature of several of our measures and their lack of formal validation work to demonstrate their construct validity. Another limitation is that none of our respondents did experience 5-MeO-DMT. Some previous work has suggested that this compound may especially produce effects that share striking phenomenological similarities with NDEs (Michael et al. 2023). 5-MeO-DMT is of particular interest as it tends to produce less visual imagery (Uthaug et al. 2020) compared to other psychedelics and thus may match better the subjective effect profile of NDEs we found. Future within-subject comparison studies should explore the overlap between 5-MeO-DMT and NDE to address this possibility.

Conclusion

Overall, the results of the present study are consistent with the existing literature suggesting some overlap between NDEs and PEs, their attribution, and their psychological impact. Intriguingly, we report here that the phenomenology of both experiences shares so-called 'mystical-like' features while diverging in sensory ones. Future work could explore if the degree of overlap of the experience induced by atypical psychedelics (e.g. ketamine and salvinorin A) is stronger with NDEs, compared with serotonergic psychedelics, in individuals who have had both experiences.

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Author contributions

C.M., R.C.-H., and C.T. were involved in conception and methodology design of the study and ethical procedures. C.M. and C.T. wrote the manuscript. C.M. obtained the data. C.M. and C.T. led the implementation and the coordination of the study. C.M. and C.T. analysed the data. All authors contributed to manuscript revision.

Conflict of interest

None declared.

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Data availability

Data are available on request.

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